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New York Entomological Society.

VOL. XXIX.

MARCH, 1921.

No. 1.

RECORDS OF CICADAS FROM NORTH AMERICA WITH DESCRIPTIONS OF NEW SPECIES.

By WM. T. DAVIS.

NEW BRIGHTON, STATEN ISLAND, N. Y.

In the present paper additional records of distribution are given for several species recently described by the writer, and four new species are recognized, one of them being *Okanagana nigriviridis*, from San Bernardino Co., California, one of the most beautiful of North American Cicadas. Two others are described from the same region, which seems to contain Cicadas not to be found elsewhere in California.

Tibicen cultriformis (Davis).

In the original description published in this JOURNAL in 1915, two males and two females were recorded from Arizona. An additional male from Nogales, Arizona, October 11, 1918 (G. A. Kusche), collection California Academy of Sciences, has since been examined.

Tibicen inauditus Davis.

In the original description published in this JOURNAL in 1917, three males, collected July 15, 1917, by Miss M. McGill, in Oldham County, northern Texas, are recorded. Miss McGill has since collected at Tascosa in the same county, a male on June 25, 1918, and two males on July 12, 1919. These specimens are all marked alike and expand about 65 millimeters each. They resemble, but are much

smaller, have less prominent eyes, and are differently marked from what we identify as *Tibicen montezuma*, examined from Texas and Arizona, which expands from 75 to 80 millimeters.

Tibicen cinctifera (Uhler). Pl. I, figs. 1, 2 and 3.

This species was described in the Transactions of the Maryland Academy of Science, 1, p. 156, 1892, under the name of *Cicada cinctifera*. The original description calls for an insect with front wings expanding from 76 to 85 millimeters, with the "tip and middle of base of tergum coated with white powder," and the "opercula greenish white, black at base, pruinose, triangular, a little rounded at tip, less than half as long as the venter." Of the material examined Uhler says: "Three specimens from Las Cruces, New Mexico, have been kindly sent to me by Mr. C. H. Tyler Townsend, and a large female was captured in Northern California by my friend, James Behrens."

The Uhler collection, in the United States National Museum, was examined in June, 1920, for the specimens mentioned in the original description. The following were found: male with "Las Cruces" on first label, "129" on second label, "P. R. Uhler collection" on third label, and "*Cicada cinctifera* Uhler, New Mex." on fourth label; male labeled "Las Cruces, P. R. Uhler collection, 129," and a female bearing three labels reading "N. Calif., Behrens, P. R. Uhler collection." These specimens, which are no doubt three of the four mentioned in the original description, have the "tip and middle of base of tergum coated with white powder," and the opercula a little rounded at the tips, with the outer edges nearly parallel to each other. In all three the costal margin of the fore wing is colored a rather bright orange to the end of the radial cell. Also in the United States National Museum there are two males and four females from Brewster Co., Texas, Rio Grande, June 13-17, 1908, collected by Mitchell and Cushman, that are like the typical material in the shape of the opercula and in coloring.

In the writer's collection there are the following specimens like Uhler's types of *cinctifera*: a male from Del Rio, Texas, Devil's River, July 3, 1917, collected by Dr. H. H. Knight, and a male from Mesilla, New Mexico, June 28, 1897, received from Prof. Albert P. Morse. Mesilla is in Donna Anna Co., New Mexico, on the Rio Grande and within five miles of Las Cruces the type locality.

Lately three males and three females have been examined, collected about five miles from El Paso, Texas, June 23, 1919, by Mr. H. H. Willis, and kindly sent to me by Mr. E. R. Sasscer of the Federal Horticultural Board. In the Academy of Natural Sciences, Philadelphia, there is a male from Langtry, Valverde Co., Texas, Aug. 24, 1912, 1,050-1,550 ft., collected by Rehn and Hebard.

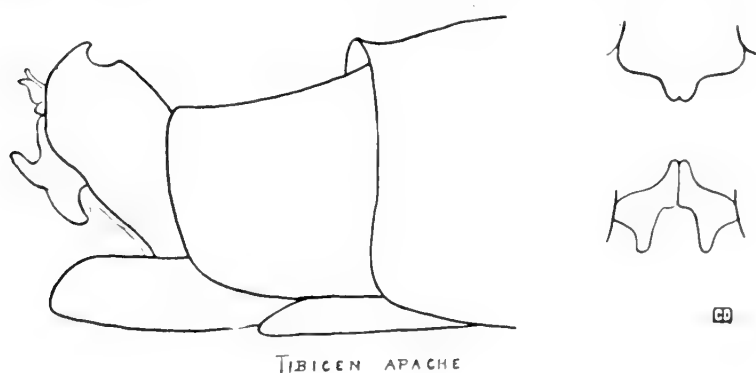
On plate 4, figure 25, Genera Insectorum, there is a figure of a cicada said to be *cinctifera*, but the fore wing is much too broad in proportion to its length, as will be noted by comparing it with the figures on the plate accompanying this article reproduced from photographs of the Mesilla male, and one of the El Paso females, referred to above.

Another species heretofore confused with *cinctifera*, and apparently more common than it, is here described as new.

Tibicen apache new species. Pl. I, figs. 4, 5 and 6.

Type male and allotype female from Florence, Arizona, July 29, 1917 (Dr. H. H. Knight). Davis collection.

Resembles *Tibicen cinctifera* (Uhler), but has sharper pointed opercula, the outer sides of which are not parallel, but converge; is without the central pruinose spot at the base of the tergum, and instead of having the dorsal part of segment eight all pruinose, the whitened area is reduced to two spots with



a black space between. In the allotype the plates that correspond to the opercula of the male, are sharper pointed than in *cinctifera*, the double notch in the last ventral segment is usually deeper, the terminal spine is more robust, that is, has a broader base, and the abdomen is less tapering at the extremity. In the three types of Uhler's *cinctifera* in the United States National Museum, the costal margin of the fore wing is bright orange to the end of the radial

cell, also the hind margin of the pronotum or collar, whereas in *apache* the color is light yellow or straw-color. The membranes at the base of both pairs of wings are orange or at least usually much darker than in *apache*, where they are white or light gray. Some of these differences in structure and color are more clearly brought out in the illustrations.

MEASUREMENTS IN MILLIMETERS.

	Male Type.	Female Allotype.
Length of body	25	25
Width of head across eyes	10	10
Expanse of fore wings	71	75
Length of operculum	6.5	

In 1917, Dr. H. H. Knight and Dr. Joseph Bequaert, while in Arizona, collected many specimens of this species, which were later recorded by the writer in this JOURNAL for December, 1917, under the name of *Tibicen cinctifera*. As a matter of fact, only the male from Del Rio, Texas, Devil's River, July 3, 1917, was of that species, all of the remainder belonging to what is here called *apache*.

The following typical material of *apache* from Arizona is in the writer's collection: Florence, July 29, 1917, fifty-four males, thirteen females (Dr. Knight and Dr. Bequaert); Black Canyon, Bumble Bee, July 31, 1917, male (Dr. Knight); Tempe, August 1, 1917, four males, two females (Dr. Bequaert); Grand Canyon, Lower Bright Angel trail, August 2, 1917, three males (Dr. Knight); Buckeye, August 7, 1917, six males, twenty-one females on poplars along irrigation ditch (Dr. Knight and Dr. Bequaert); Palomas, August 8, 1917, one male (Dr. Knight). Phoenix, July, 1913, thirteen males, three females (Dr. R. E. Kunze), and July, 1914, twenty-eight males and seven females (Dr. Kunze). There are also numerous examples of this species in the collection of the United States National Museum. Dr. Knight says of the specimens from Florence: "On mesquite, song continuous, even toned, moderately shrill note."

There are several color varieties of *apache*, the commonest one having the body mostly brown or brownish instead of black. It was at first thought that specimens having the dorsum light brown variegated with pale straw-color, were immature individuals, but the accumulation of considerable material has shown that this is not the case. Specimens of the pale variety range all of the way in color

from a light brown with darker marks, particularly on the head and mesonotum, to very pale, almost unicolorous individuals from Utah. The following belong to the variety: Palomas, Arizona, August 8, 1917, two males (Dr. H. H. Knight); Yuma, Arizona, July 5, 1918, male and female (A. M. Gaudin); Yuma, California, August, female (Prof. H. F. Wickham); Riverside Co., California, female (E. R. Leach); Needles, California, August 3-4, 1919, eight males (Rehn and Hebard); Washington Co., Utah, male and "Utah," male, both without date. In the Academy Natural Sciences, Philadelphia, there is a female, collected at light, Yuma, Arizona, July 28, 1907 (Rehn and Hebard).

In Howard's Insect Book, plate 28, figure 13, a female *Tibicen apache* is figured under the name of *Cicada vitripennis*.

Tibicen transversa (Walker). Pl. II, fig. 1.

This species was described from Vera Cruz, Mexico, by Francis Walker in *Insecta Saundersiana*, 1858, and was later figured by Mr. Distant in *Biologia Centrali-Americana*, Homoptera, plate 2, figure 1. In this figure the first and second transverse veins of the fore wing are not as clouded as in the two specimens, I have examined, or as called for by Walker, who says: "Fore wings with the first and second transverse veins clouded with brown." Mr. Distant, however, in the text says: "Opercula long, triangular, reaching the base of the fourth abdominal segment. Apices of the opercula obtuse; tegmina spotted with fuscous near the apex." Uhler, in the *Transactions, Maryland Academy of Science*, 1, p. 155, 1892, states of *Cicada transversa*: "The type came from Mexico. I have examined a specimen from Texas." In the list of Coleoptera, Lepidoptera, Diptera and Hemiptera collected in Arizona by the Entomological Expeditions of the University of Kansas in 1902 and 1903, *Kansas University Science Bulletin*, volume 2, number 12, May, 1904, Prof. F. H. Snow records *Cicada transversa* from two localities in southwestern Arizona, collected in 1903. We have examined some of these specimens and they are what is described in this paper as *Tibicen apache*.

The following specimens of *transversa* have been examined:

Padre Island, Texas, August 23, 1915, male. Collection University of Michigan, and examined through the courtesy of Prof. F. M. Gaige. This specimen is figured.

Galveston, Texas, August 22, 1918, male (E. C. Wurzlow). Davis collection. Mr. Wurzlow wrote that he heard this insect singing, and found it on a fence over a clump of *Amaranthus*. He also heard several others in the gardens about the houses.

***Tibicen texana* (Davis).**

In the original description in this JOURNAL for 1916, this species was recorded from three localities in Cameron County, southern Texas. The following Texas specimens have since been examined: Spofford, Kinney Co., July 8, 1907, male; Cotulla, Lasalle Co., 450 ft., August 13-14, 1912, male; Uvalde, Uvalde Co., 1,000-1,100 ft., Aug. 21-22, 1912, male; Del Rio, Valverde Co., 900-1,100 ft., Aug. 22-23, 1912, male and female in copulation; Midland, Midland Co., 2,779 ft., Sept. 19, 1912, male. These six specimens are in the Academy of Natural Sciences of Philadelphia and were collected by Rehn and Hebard.

The female of this species has never been described, so it may be well to state that the notch in the last ventral segment is broadly V-shaped with the sides of the V slightly sinuate, as in *olympusa* (*sordidata*), but judging from the only female of *texana* examined the V incision has the sides more evenly curved and broadly rounded out than in *olympusa*. In addition the head is broader than in that species.

***Tibicen vitripennis* var. *bequaerti* Davis.**

This insect was described and figured in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY for December, 1917, under the name of *Tibicen viridifascia* var. *bequaerti*. The type and four paratypes were recorded from Richmond, Texas, June 23, 1917, and four paratypes from Wharton, Texas, June 24, 1917, all collected by Dr. H. H. Knight. It was stated at the time that the eyes were prominent in these specimens; also that the basal cell of the fore wing was clear, slightly touched with black along the fore margin. More material has been examined, and the writer now thinks that this insect should be considered as a variety of *vitripennis* Say, instead of *viridifascia* Walker, particularly on account of the more elongate shape of the fore wings, and the clearer basal cell. In the writer's collection there are at present thirty examples of *vitripennis*, and when these are compared with examples of variety

bequaerti having a like expanse of wings, they invariably are much narrower across the eyes, in other words the variety is a broad headed insect as shown by the figure accompanying the original description.

In the United States National Museum there is a female specimen of *Tibicen bequaerti* from Columbus, Texas. It bears a label stating that it was figured in the "Insect Book, Pl. 28, fig. 15." The wings in this specimen expand 76 mm., head 12 mm. across eyes, length of body 25 mm., ventral notch broad and shallow. A female *Tibicen vitripennis* Say from Louisiana with length of body also 25 mm. has the width of head 11 mm., ventral notch deeper than in the Texas example and double. A female *vitripennis* from Alexandria, La., June 22, 1910 (E. S. Tucker), expands 75 mm., length of body 25 mm., has the width of the head 11 mm.; ventral notch broad and shallow, and feebly double. In the writer's collection there is a female *bequaerti* from New Orleans, La., June, 1918 (H. E. Hubert), with expanse of fore wings 72 mm., length of body 23 mm., and width of head across eyes 10 mm. The ventral notch is simple.

It may not prove a very constant character, but in all of the specimens of *bequaerti* the transverse black stripe on the head between the eyes, does not reach the eyes, whereas in *vitripennis* the stripe continues right across the front of the head in 28 out of the 30 specimens at hand, and in the two exceptions the stripe almost reaches the eyes.

***Tibicen knighti* Davis.**

This species was described and figured in the JOURNAL OF THE N. Y. ENTO. Soc. for December, 1917, shortly after which Dr. H. H. Knight contributed the following additional information: "The new *knighti* was taken in Sabino Canyon of the Santa Catalina Mountains, at an altitude of about 6,500 to 7,000 feet. I spent about five minutes trying to locate the first one; I could not see it, and looked first for a Cicada and then for an Orthopterous insect. I had to give it up and scare it out of the bush before locating it. The species preferred to alight on the shrubbery that covered the rocky slopes of the canyon, among the many giant cacti. I remember I saw one female and missed it by not being careful."

Tibicen arizona (Davis).

When the original description of this species was published in this JOURNAL for March, 1916, only males had been examined, all collected by Prof. F. H. Snow in the Santa Rita Mts., Arizona. Since then a female collected by Prof. Snow at the same place and time has come to hand. It is like the males in general color and markings. It expands 54 millimeters; length of body 17 millimeters; last ventral segment with the shallow notch broadly open and its sides slightly sinuate. In the allied species *castanea*, the notch is broadly open, but is double.

Several specimens of a species closely resembling *arizona*, from Cuernavaca, about 40 miles south of Mexico City, Mexico, have been examined. One bears a label reading "*Selymbria modesta* Dist.," with "(Uhl)" in the lower left-hand corner. Distant's *modesta*, now placed in the genus *Ollanta*, has the "tympanal coverings large, their apices subacute anteriorly but not interiorly covering cavities." In *arizona* and the species from Cuernavaca, the tympana completely cover the cavities.

Okanagana mariposa Davis.

The following California records of this species, originally described from Mariposa County, were received in 1920: Upland, San Bernardino Co., June 18, 1920, male; July 1, 1920, five males, four females; July 2, 1920, male and two females (Miss E. P. Hewlett). Angeles Forest, Barley Flats, 5,000 ft., June 24, 1918, two females (Victor Duran). Mr. Duran writing of this species states that he found it "extremely abundant in the chaparral in the vicinity of Barley Flats, Sierra Madre Mountains on June 24, 1918. . . . That day and the one preceding were hot and insects of all kinds were most unusually abundant." Alhambra, Los Angeles Co., July 4, 1920, twenty-nine males and nineteen females; July 6, 1920, two males and ten females. Under date of July 8, 1920, Mr. Duran wrote of this lot, they occurred "in the chaparral of the upper parts of the canyons of the Tujunga and West Fork of the San Gabriel River, altitude 4,000 to 5,500 feet." Nevada Co., August 11, and August 13, 1920, two males (E. R. Leach).

Okanagana rimosa (Say).

In this JOURNAL for 1919, page 203, it was stated that Say's two specimens of this species, collected by Nuttall in 1811, no doubt came

from along the Missouri River in what is now North or South Dakota, and a male from Sioux City, on the Missouri, was identified at that time as filling in every way Say's description. Lately Mr. O. A. Stevens has kindly given me a male collected June 15, 1915, at Mandan, Morton Co., near Bismark, North Dakota. This specimen comes from what is believed to be near the type locality. It is a trifle smaller than the Iowa example, expanding 59 millimeters, but otherwise is the same.

Okanagana nigriviridis new species. Pl. II, fig. 2.

Type male from Upland, San Bernardino Co., California, July 1, 1920 (Miss Esther P. Hewlett). Davis collection.

Allotype from same locality, July 2, 1920 (Miss Hewlett). Davis collection.

A conspicuously beautiful green and black species with slim body and narrow wings.

Head across eyes nearly as broad as front margin of the pronotum, eyes and front both prominent; median sulcus well defined. Pronotum with the humeral angles rounded, and the anterior angles well defined. A slight notch each side near the middle of the outer edge of the pronotum. Wings narrow, rather pointed, with the outer edge evenly curved. Beneath, but slightly hairy, the hairs confined to the region about the legs and the sides of the face; the



OKANAGANA NIGRIVIRIDIS

transverse rugæ are covered with a silvery pubescence. The underside of the abdomen is nearly smooth except for two spots of silvery pubescence on each segment. The upper side of the body is nearly smooth except that there is a silvery pubescent area each side on each of the segments; there are the usual hairs behind the eyes. The last ventral segment of the type is rounded, slightly

sinuate near the center; in the allotype the last ventral segment is narrowly notched, the notch extending only half way to the base. Uncus when viewed in profile arched above, sinuate beneath, and when viewed from above notched at the extremity.

Head black above, supra antennal plates and an irregular area behind the ocelli, green. Pronotum green variegated centrally with black, especially in the depressions or grooves. Mesonotum green with four obconical black spots along the anterior margin, the outer pair about twice as long as the central pair; from the central pair extends a black line backward to the elevated X, where it either forks or is represented by two spots. There are also two black spots, one near each of the anterior extremities of the X. There is an irregular black line extending each side from the elevated X to the base of the fore wings. Metanotum green, irregularly spotted with black near the base of each hind wing. Front wings with the venation conspicuously black, except the yellowish-green front margin, the clouded green basal cell, and the green veins surrounding the anal area. In the hind wings the marginal cells are surrounded by more delicate blackened veins, while the venation on the basal half of the wing is greenish, the anal areas being opaquely greenish-white. Membranes at base of both pair of wings are greenish-white, those of the front wings slightly yellowish on posterior margin. Abdomen green above with the commencement of a black dorsal vitta on the first segments, a rather conspicuous black stripe on the front margin of segment three; less conspicuous ones on segments two and four, or the last may be wholly wanting. In addition segments three to six have two black spots on each side, the upper rounded and the lower linear in form. In the allotype there is an irregular black spot each side on segment nine. Uncus green, blackened along lower margin. Beneath, the head is black, the frontal sulcus partly green, the terminal part of the rostrum black, the legs green striped with black, claws and spines tipped with black, abdomen green with the usual basal dark spot, which in this instance is much reduced; valve green.

MEASUREMENTS IN MILLIMETERS.

	Male Type.	Female Allotype.
Length of body	25	25
Width of head across eyes	7	7
Expanse of fore wings	64	65
Length of valve	5	

In addition to the type and allotype two males were collected at Upland, California, one July 20, and the other July 29, 1920. Miss Hewlett writes: "One which I caught was singing more like a Katydid; not a steady song." In some of the species of *Okanagana* the song is quite steady.

The shape of the head in *nigriciridis* is much like that of *synodica*, also as in that species the valve is long. The dark markings on the head and thorax are also similar. On the other hand the fore wings are not as broadly rounded at the extremities as in *synodica*, the radial cell is more elongate, and the eighth apical area is proportionately longer. For the present this very distinct species can be placed next to *arctostaphyle*.

Okanagana synodica (Say).

This species has been recorded from Montana, Nebraska, Kansas, Colorado, New Mexico and Texas. (See JOURNAL N. Y. ENTO. SOC., June-Sept., 1919, p. 211.) The following records extend its range to two additional states: Parowan, Utah, two males, Palmer's assorting, No. 1201, Uhler collection, U. S. Nat. Museum. Medicine Bow, Wyoming, about 6,600 ft., June 22-24, 1920, four males, collection Am. Museum of Natural History. Dr. Frank E. Lutz collected these four specimens and noted at the time "the small brown Cicada on grass, has a continuous note, but sometimes continues for only a short time."

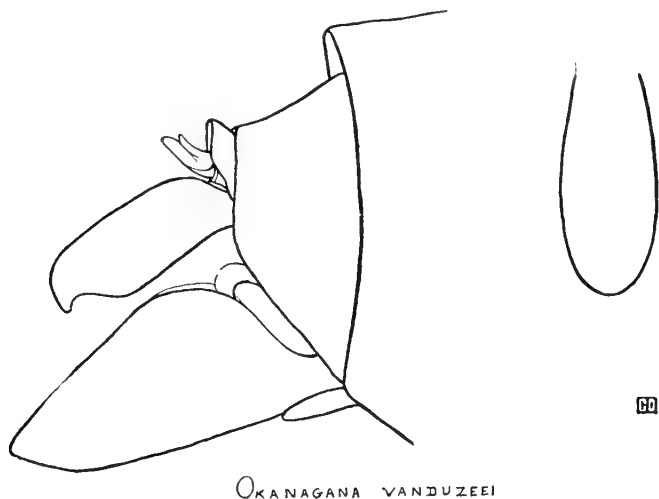
Okanagana balli Davis.

In the original description, JOURNAL N. Y. ENTO. SOC., June-Sept., 1919, this species is recorded from Iowa, Minnesota and South Dakota. Additional records are as follows: Lake Okoboji, Iowa, July 6, 1917 (L. L. Buchanan), collection U. S. Biological Survey. Lake Okoboji, Iowa, July, 1919, male fed to a young Arkansas Kingbird by its parent and taken from the young bird by T. C. Stephens. About seven or eight other specimens were fed to the young birds. Blue Rapids, Kansas, June 20, 1919, three males and a female (O. A. Stevens). "Nebraska," male, collection Mus. of Comparative Zoology, Cambridge, Mass. Kalispell, Flathead Co., Montana, June, male (Prof. H. F. Wickham).

Okanagana vanduzeei Distant. Pl. II, fig. 3.

Mr. E. R. Leach has kindly presented me with six males of *O. vanduzeei* var. *consobrina* collected in Mendocino County, California from June 20 to 27, 1920. These northern specimens are a little smaller than the average from the type locality, San Diego County, but otherwise there appears to be no difference.

We here present a figure of the genitalia of a male *O. vanduzeei*, so that a comparison may be made with the new *Okanagana simulata*.



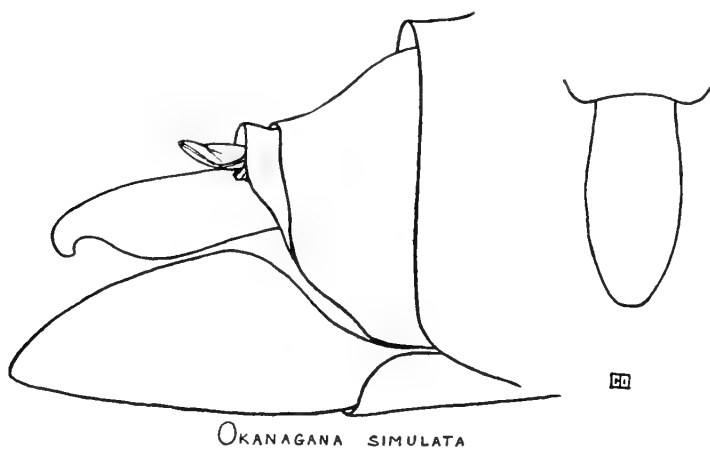
***Okanagana simulata* new species. Pl. II, fig. 4.**

Type male from Upland, San Bernardino Co., California, June 21, 1920 (Miss Esther P. Hewlett). Davis collection.

Allotype from same locality, June 29, 1920 (Miss Hewlett). Davis collection.

Resembles *Okanagana mariposa* in size and color, and *Okanagana vanduzeei* somewhat in color and form and in having a hooked uncus.

Head rather large and only a little narrower than the front margin of the pronotum; front conspicuously hairy and moderately produced; median sulcus



well defined. Pronotum with both the humeral and anterior angles rounded. Sides of pronotum without serrations. Front wings rather pointed with the outer edge forming a somewhat straight line. Beneath conspicuously hairy; last ventral segment broadly rounded and somewhat truncate at the extremity. In the female allotype the notch is sharp at the bottom with the sides somewhat sinuate. Uncus when viewed in profile hooked at the extremity.

Head black with the supra-antennal plates orange in the type; the allotype has in addition a spot on the front and the groove behind the middle ocellus dull orange. The transverse rugae black, bordered by orange, but so covered with silvery hairs that the colors are considerably hidden. Pronotum black, the hind margin edged with dull orange. In the allotype the front margin is also narrowly edged with dull orange, and the grooves show faintly the same color. Mesonotum black, bordered on the sides posteriorly with dull orange. The elevated \times black, touched with dull orange at top and on the hind limbs; in front of the fore limbs there are the usual four orange spots arranged in a semicircle. Metanotum black, edged in part posteriorly with dull orange. Front wings with the venation almost black, with a submarginal dull orange streak extending to the end of the radial cell. Base of fore wing blackened, including the basal cell, membrane orange. Hind wings orange and dark brown or almost black at base, with the outer veins lighter than in the fore wings. Tergum black, but feebly shining, hairs silvery, uncus black. The legs are irregularly striped with orange; the femora paler at the outer joints. Beneath the abdominal segments are black centrally, edged posteriorly and on the sides with orange; the last segment is broadly edged with orange. Valve black beneath, orange along the upper margin.

MEASUREMENTS IN MILLIMETERS.

	Male Type.	Female Allotype.
Length of body	27	26
Width of head across eyes	9	9
Expanse of fore wings	75	77
Length of valve	5	

In addition to the type and allotype three males were collected at Upland, California, by Miss Hewlett in 1920, as follows: June 23, July 1 and July 5. In the Museum of Comparative Zoology, Cambridge, Mass., there is a male collected at Claremont, California, June 8, 1882. This locality is five or six miles to the west of Upland. I am indebted to Mr. Nathan Banks for the privilege of examining this specimen.

While this species on account of its size, large head, rather straight outer margin to the fore wings and coloring, resembles

Okanagana mariposa, it differs in having a hooked uncus instead of a nearly straight one; it is also more hairy. From *Okanagana vanduzeei*, which has a hooked uncus, it differs in being much larger, in having the eyes more prominent, the anterior angles of the pronotum more rounded, the front wings with the outer margin straighter, and the last ventral segment more rounded at the extremity, instead of somewhat sinuate. It, however, should be placed next to *vanduzeei*.

***Okanagodes gracilis* Davis.**

In the original description, JOURNAL N. Y. ENTO. SOCIETY, June-Sept., 1919, this species was reported from Utah, and two localities in Arizona. On August 6, 1919, at Bagdad, San Bernardino Co., California, Mr. Morgan Hebard collected two males on low plants in an arid environment. He was attracted by the song, which he at first thought was produced by an Orthopterous insect. The Cicadas ceased singing when he was still some distance from them, which made their final detection rather difficult.

***Platypedia putnami* var. *keddiensis* Davis.**

Recorded from Keddies, Plumas Co., and Lassen Co., California, also Corvallis, Oregon. Recently Mr. E. R. Leach kindly sent me two males and a female collected May 23, 1920, in Nevada Co., California.

***Platypedia laticapitata* new species. Plate II, fig. 5.**

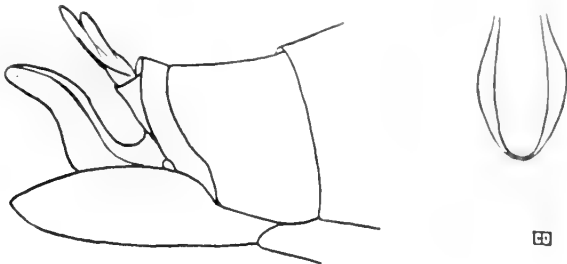
Type male, Upland, San Bernardino Co., California, June 24, 1920; allotype female from the same locality, July 1, 1920; both collected by Miss Esther P. Hewlett, and in Davis collection.

Resembles *Platypedia aperta* Van D. in its narrow fore wings; the uncus, however, is much narrower, and more as in *P. vanduzeei*, from which it differs in not having the broad wings nor the very hairy head of that species. The head is also very hairy in *minor* and *barbata*.

Front of head not prominent and about as in the other small species of the genus; median sulcus moderately well defined and broadening on the lower part of the face. The head is wide across the eyes, and the pronotum broadens from the collar toward the anterior margin, so that it is proportionately wider just behind the eyes than in any other *Platypedia* so far examined. Hairs on the greater part of the dorsal surface short and appressed, giving the insect a dull gray-black appearance; in *aperta*, *vanduzeei*, *minor* and *barbata* the hairs on the upper surface of the thorax are rather long, upright and dark colored. Hairs on the underside of the body longer and lighter colored, as is

usual. The fore wings are narrow, and have eight rather long and narrow apical areas; the costal margin is evenly curved. The uncus is upturned at the extremity as in *tanduzeei*, but is more broadly rounded on the end than in that species. Last ventral segment in the allotype quite hairy, with the notch broadly v-shaped.

General color dull black, the lighter hairs giving a general grayish appear-



PLATYPEDIA LATICAPITATA

ance. Fore femora black on nearly the entire inner side; chestnut colored striped with black on outer side; extremities of femora pale. The hind margin of the pronotum, as well as the other usual paler markings are dull orange, while the membranes at the base of the fore wings are brighter orange.

MEASUREMENTS IN MILLIMETERS.

	Male Type.	Female Allotype.
Length of body	17	19
Width of head across eyes	6	6
Expanse of fore wings	44	43
Length of valve	2.5	

This insect should be considered just after *aperta* in the Key to the Genera and Species of *Platypedia* and *Neoplatypedia*, published in the JOURNAL, N. Y. Entomological Society, for June, 1920. Only the type and allotype have been examined.

EXPLANATION OF PLATES I AND II.

PLATE I.

- Fig. 1. *Tibicen cinctifera* (Uhler). Male.
- Fig. 2. *Tibicen cinctifera* (Uhler). Female.
- Fig. 3. *Tibicen cinctifera* (Uhler). Under side, enlarged.
- Fig. 4. *Tibicen apache* Davis. Type, male.
- Fig. 5. *Tibicen apache* Davis. Allotype, female.
- Fig. 6. *Tibicen apache* Davis. Under side, enlarged.

PLATE II.

- Fig. 1. *Tibicen transversa* (Walker).
Fig. 2. *Okanagana nigriviridis* Davis. Type.
Fig. 3. *Okanagana vanduzeei* Distant.
Fig. 4. *Okanagana simulata* Davis. Type.
Fig. 5. *Platypedia laticapitata* Davis. Type.
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NOTES ON INDIANA HALTICINI WITH CHARACTERIZATION OF A NEW GENUS AND DESCRIPTIONS OF NEW SPECIES.

BY W. S. BLATCHLEY,

INDIANAPOLIS, IND.

During the ten years that have intervened since my "Coleoptera of Indiana" was issued, a number of interesting Halticini have been added to the known fauna of the State. Some of these are evidently new to science and one of them belongs to none of the genera included by Dr. Horn in his "Synopsis of the Halticini of Boreal America."¹ I have therefore, in this paper, founded for it a new genus, have described eight species and named one variety believed to be new, and have added notes on a number of others. The order followed is that of the genera and species of the Tribe in the Coleoptera of Indiana. My thanks are due to H. C. Fall, of Tyngsboro, Mass., for comparisons made and suggestions given, examples of all the supposedly new species having been submitted to him.

Disonycha pennsylvanica parva new variety.

This is the small form occurring about a cypress swamp in Knox County, and characterized but not named by me on page 1188 of the "Coleoptera." Since it differs from *pennsylvanica* in having the elytra non-alutaceous, almost wholly without punctures and always with a double fold or sulcus along the median black stripe, it may in time be recognized as a valid species, since no intermediate forms have been seen. I found it in numbers about a similar swamp at Sanford, Fla., in April, 1913, and it is probably the form mentioned

¹ Trans. Amer. Ent. Soc., XVI, 1889, pp. 163-320.



(CICADIDAE.)



(CICADIDAE.)



without name by Horn, loc. cit., p. 203, as occurring in Florida and Louisiana, though he does not refer to the most salient differences between it and *pennsylvanica*.

The small Halticids belonging to the genus *Longitarsus* are much more numerous in this country than is generally supposed. I have elsewhere described three very distinct forms from Florida which were not included in Horn's paper, and have at hand four others which have been heretofore unknown. They frequent, for the most part, the dense subaquatic vegetation along the borders of marshes and ponds, where their small size precludes their being easily seen. They are best taken by sweeping, but this method of capture usually prevents their food plant being definitely known unless, as is seldom the case, the vegetation is of a single species.

The study of this genus, while a most interesting pastime, is beset with many difficulties. Crotch passed it up with the statement² that: "The species are beyond my skill to unravel from the incomplete material before me." Horn, loc. cit., p. 276, stated that: "The genus is an extremely difficult one to deal with, certainly more so than any other Halticini of our fauna," yet he made a very satisfactory key to 23 species from all parts of the country, 15 of which he described as new.

Our eastern species of *Longitarsus* group themselves naturally into two divisions, one having the wings present, the elytra wider at base than thorax and with umbones and humeri distinct; the other apterous, the elytra not wider at base than thorax, the humeri, at the most, broadly rounded and the umbones absent or very faint. These groups should at least bear subgeneric rank. In order that our eastern species may be the more readily determined I have prepared the accompanying key to the 19 now known from east of the Mississippi River. In my study of both these and other small Coleoptera I have found that the presence or absence of an alutaceous surface is one of the most stable characters to be used in separating closely related species. This and the color, which varies but little in mature specimens of *Longitarsus*, and the length, which can also be depended upon within the limits given, are the principal secondary characters I have used in the key.

² Proc. Acad. Nat. Sci. Phil., 1873, 65.

KEY TO EASTERN SPECIES OF LONGITARSUS.

- a. Elytra at base distinctly wider than thorax; humeri and umbones more or less evident; body winged. (Subgenus *Longitarsus*.)
- b. Color either testaceous or reddish-brown.
- c. Larger species, length more than 2.2 mm.
- d. Rufo-testaceous, upper surface not alutaceous; length 3 mm.
subrufus Lec.
- dd. Rufo-castaneous; length not more than 2.5 mm.
- e. Joints 2, 3 and 4 of antennæ subequal in length or joint four but slightly longer than two; surface not alutaceous.
alternatus Ziegl.
- ee. Joints 2, 3 and 4 of antennæ gradually longer, four being double the length of two; surface minutely alutaceous.
arenaceus new species.
- cc. Smaller species, length not over 2 mm.
- f. Upper surface nowhere alutaceous.
- g. Antennæ with four basal and three apical joints reddish-yellow, the intermediate joints fuscous; elytra rufo-testaceous, each with a fuscous cloud at middle; length 2 mm.
heliophyti Horn.
- gg. Antennæ fusco-piceous, the three or four basal joints alone pale; elytra dull testaceous without fuscous median spots but with a vague common w-shaped scutellar blotch; length 1.3-1.5 mm.....**fuscicornis** Blatch.
- ff. Upper surface, at least of elytra, distinctly alutaceous.
- h. Joints 2, 3 and 4 of antennæ subequal in length; elytra not shining but with a distinct greasy aspect.
- i. Elytra nearly three times as long as thorax, coarsely alutaceous; form more robust, convex; punctures of thorax very evident; length 2 mm.....**testaceus** Melsh.
- ii. Elytra only twice as long as thorax, minutely alutaceous; form more slender, subdepressed; punctures of thorax almost invisible; length 1.6-1.8 mm.....**cotulus**³ Blatch.
- hh. Joints 2, 3 and 4 of antennæ unequal, gradually longer; elytra alutaceous but shining and without a greasy aspect, the punctures distinctly coarser than in either *testaceus* or *cotulus*; length 1.8-2 mm.....**suspectus** new species.
- bb. Color either piceous or dark brown.
- j. Larger species, length 3-3.5 mm.....**traductus** Horn.
- jj. Smaller, not over 2.5 mm.
- k. Upper surface strongly shining, not at all alutaceous.

³ In lifting up an elytron of the type the wing must have adhered to the under surface and was not discovered, as I described it erroneously as apterous, whereas the wings are as fully developed as in any other species of this group.

- l.* Joints 2, 3 and 4 of antennæ unequal, successively longer; color dark brown with a faint bronze luster; length 2.3-2.5 mm.....**turbatus** Horn.
- ll.* Joints 2, 3 and 4 of antennæ subequal in length; color piceous; length less than 2 mm.
- m.* Punctures of thorax very fine, almost invisible; legs piceous; length 1.8 mm.....**erro** Horn.
- mm.* Punctures of thorax moderately coarse, very distinct; legs dull yellow; length 1.5 mm.....**pygmæus** Horn.
- kk.* Upper surface distinctly alutaceous, moderately shining; color brownish-piceous; elytral punctures coarse; length 2-2.2 mm.....**melanurus** Melsh.
- aa.* Elytra at base not wider than thorax; humeri and umbones absent or very feeble; body apterous. (Subgenus *Apterius*.)
- n.* Color either testaceous or reddish-brown.
- o.* Abdomen coarsely punctate; length 2-2.2 mm.....**insolens** Horn.
- oa.* Abdomen smooth or very indistinctly punctate; length not over 1.8 mm.
- p.* Thorax with distinct coarse, deep scattered punctures; pygidium wholly concealed; elytra with coarse, deep punctures; length 1.3 mm.....**perforatus** Horn.
- pp.* Thorax with fine, shallow, almost invisible punctures; pygidium plainly visible; elytra with much finer, more shallow punctures.
- q.* Pale reddish-brown, feebly shining; form elongate, subcylindrical; length 1.8 mm.....**subcylindricus** Blatch.
- qq.* Dark reddish-brown, strongly shining; form short-oval; length 1-1.2 mm.....**misellus** new species.
- nn.* Color either black or very dark chocolate-brown.
- r.* Color black; punctures of elytra coarse, dense; length 1-1.2 mm.....**solidaginis** Horn.
- rr.* Color dark chocolate-brown; punctures of elytra fine and sparse; length 1.5 mm.....**saltatus** new species.

Longitarsus arenaceus new species.

Broadly oval, convex, robust for the genus; winged. Reddish-castaneous or brick-red, shining; apical half of antennæ and hind femora and sutural line of elytra slightly darker. Head with frontal carina scarcely evident, postocular tubercles prominent. Antennæ stout, joints 2, 3 and 4 distinctly increasing in length, the fourth double the length of the second. Thorax subquadrate, one-fourth wider than long, sides feebly rounded, front angles with a prominent, obliquely truncated oval nodule, hind ones rounded into base; disk minutely alutaceous, very sparsely and finely but distinctly punctate. Elytra oval, one-third wider at base than thorax; humeri rounded, umbones feeble but evident, disk minutely alutaceous, very finely, evenly and rather densely punctate. Abdominal segments 1-4 gradually diminishing in length, all distinctly punctate. Length, 2.2-2.5 mm.

Pine, Lake Co., Ind., May 15-20; Mineral Springs, Porter Co., Sept. 10. Taken by A. B. Wolcott in the sand covered district along Lake Michigan where it occurs mainly beneath the prickly pear cactus *Opuntia humifusa* Raf. This species was erroneously included in the Coleoptera of Indiana, p. 1192, as *L. alternatus* Ziegl., but that species is non-alutaceous and has the antennal joints, 2, 3 and 4 subequal. Mr. Fall has compared for me the type of *arenaceus* with that of Ziegler's species and pronounces the two very distinct.

Longitarsus suspectus new species.

Rather broadly oval, convex; winged. Pale reddish-yellow throughout, strongly shining; apical third of antennæ often dusky. Head alutaceous, impunctate, the frontal carina prominent. Antennal joints 2, 3, 4 gradually slightly longer, the fourth one-half longer than second, but slightly if any shorter than those which follow, which are subequal. Thorax sub-elliptical, one-third wider than long, sides strongly declivent; front angles with a small obliquely truncated nodule, hind ones rounded into base; disk minutely alutaceous, very finely and remotely punctate. Elytra wholly covering the pygidium, one-third wider at base than thorax, humeri rounded, umbone evident but feeble; sides very broadly curved, sutural angle obtuse; disk finely but distinctly alutaceous, finely, evenly and very shallowly punctate, the punctures separated by nearly twice their own diameters and subseriate in arrangement. Abdomen finely and sparsely punctate, each puncture bearing a minute inclined yellowish hair. Length, 1.8-2 mm.

Pulaski, Putnam, Marion, Knox and Dubois counties, Ind., May 6-November 28. Taken by sweeping herbage about the margins of woodland ponds. Heretofore confused in my collection and probably in many others with *L. testaceus* Melsh., but smaller, comparatively broader with the upper surface much less alutaceous and therefore without the strong greasy aspect of *testaceus*. The punctures of the thorax are almost invisible, while those of the elytra are distinctly coarser than in *testaceus*. No abdominal sexual differences are visible in the series of 27 specimens at hand, though what I take to be the males are more narrow bodied, still less alutaceous and with the disparity between joints 2-3-4 of antennæ slightly greater than in the female type. From *arenaceus*, described above, this species differs in its paler color, much less robust form, in joints 2, 3 and 4 of antennæ being less unequal and in the coarser, sparser and much more shallow punctures of elytra.

Longitarsus misellus new species.

Narrowly oval, strongly convex; apterous. Dark reddish-brown; antennæ and legs reddish-yellow, the former dusky toward tips. Head minutely alutaceous, impunctate. Antennæ with joints 2, 3 and 4 subequal in length, each one-third shorter than Nos. 6-11, which are also subequal. Thorax one-half wider than long, its sides strongly declivent, their margins rounded into base; disk minutely and very sparsely punctate, the punctures just visible under the highest magnification. Elytra at base not wider than thorax, their sides very broadly and evenly curved to apex, beneath which the pygidium is plainly visible; umbones and humeri wanting; disk with punctures everywhere confused, round, shallow, separated by twice their own diameters. Abdomen very finely and distantly punctate. Length, 1-1.2 mm.

Parke Co., Ind., May 13; Marion Co., Sept. 2. Swept from herbage in low moist places. Allied to *L. insolens* Horn, but much smaller, with the punctures of thorax all but invisible and abdomen almost smooth.

Longitarsus saltatus new species.

Elongate-oval, strongly convex; apterous. Piceous or dark chocolate-brown; antennæ and legs dull reddish-yellow, the hind femora reddish-brown. Head finely alutaceous, impunctate. Eyes small, prominent, very coarsely faceted. Antennæ with joints 2, 3 and 4 subequal. Thorax one-third wider than long, sides broadly rounded; front angles with a thickened obliquely truncate nodule, side margins with a smaller spicule at apical third and another near hind angles, which are rounded into the base; disk distinctly alutaceous, finely, very sparsely and shallowly punctate. Elytra oval, widest at middle, not wider at base than thorax, sides broadly curved from base to the separately rounded apices, which leave the pygidium almost wholly exposed; umbones and humeri absent; disk minutely alutaceous, sparsely, finely and somewhat aciculate punctate, the punctures near the suture subseriate. Abdomen finely and sparsely punctate, the last ventral with a distinct but obtuse lengthwise median carina. Length, 1.5 mm.

Posey Co., Ind., Sept. 21. Taken by sweeping roadside herbage. Allied to *solidaginis* Horn, but larger, less attenuate behind and with punctures of elytra much finer and more shallow.

Longitarsus turbatus Horn.

This has proven to be almost as common in Indiana as *L. melanurus* with which it is usually confused. Numbers were taken in Marion County during the past summer by sweeping about a "wet weather" woodland pond.

Glyptina brunnea Horn.

A single specimen was taken July 20 in Marion County, while sweeping in dense upland woods. This is the first Indiana record. Horn states that it is known from Georgia, Louisiana, Texas and Wisconsin.

The species of the genus *Haltica* are also much more numerous in this country than was supposed by Horn. Since his synopsis appeared, a number of species have been described as new by Fall, Schaeffer, Woods and myself, and two others which are apparently different from any known are herewith added to the list. One of them, as well as several of the others recently described, was masquerading under the name *H. ignita* Illig, which name was for years a general dumping ground for species similar in size and general facies which could not be readily determined. Just what Illiger's species was or is no one in this country apparently really knows. By Melsheimer, Leconte, Horn and others the name *ignita* was assigned to a group of species of subdepressed, oblong form, 3-4 mm. in length, blue, greenish or coppery-golden in color, having joints 2, 3 and 4 of antennæ usually gradually longer; thorax one-half wider than long, finely and sparsely punctured, the sub-basal transverse impression loosely defined but wide and entire and consisting of a narrow, deep median line from which the front of the impression rises abruptly, the hind portion being flattened, and gradually sloping upward. Males with last ventral segment sinuate each side, forming a short median semicircular lobe which is flattened but *not* emarginate, impressed or excised, the hind edge usually slightly reflexed.

Fall first recognized⁴ that a number of species were included by these older writers under the name *ignita* and described three of them, *probata* and *suspecta* from California and *litigata* from Florida, as new, limiting the name *ignita* to a "brilliant coppery-golden form of the Middle Atlantic states." My *Haltica schwarzi*⁵ and *H. vaccinia*,⁵ described from Florida, were next taken from the *ignita* complex of Horn. Woods⁶ has since separated and described three additional

⁴ Trans. Amer. Ent. Soc., XXXVI, 1910, 153.

⁵ Can. Ent., XLVI, 1914, 141; XLVIII, 1916, 95.

⁶ Bull. 273, Maine Agr. Exp. Stat., 1918, 154.

species, *corni*, *rosa* and *ulmi*, from Maine.^{6a} Since Illiger's original description of *ignita* calls for a species having the elytra "*plica submarginali*," a character that no known American species, except *bimarginata* Say, possesses, and since none of our entomologists have seen his type and have heretofore "guessed" at what species he had in hand, it would be better, in my opinion, to either drop his name from our lists or to carry it, as Woods has done, as an unknown American species possessing an elytral submarginal fold.

From the coppery-golden form assumed to be *ignita* by Fall, and from all the species recently described from the composite *ignita* Illig. of Horn, the first of the following two species differs in the characters given sufficiently to justify its description as new.

***Haltica gloriosa* new species.**

Oval, rather strongly convex. Color a uniform brilliant reddish-purple; antennæ, tarsi and tibiæ blackish-bronzed, pubescent. Fourth joint of antennæ one-fifth longer than third, twice the length of second. Head with frontal carina distinct, sharp; eyes large but only moderately prominent; vertex impunctate. Thorax subquadrate, one-fourth wider than long, base and apex subequal in width; front angles nodulate, hind ones obtuse, sides almost parallel, feebly undulate; disk minutely alutaceous, very finely and sparsely punctate, the transverse basal impression entire, its front portion less elevated and abrupt, and hind one less sloping and more depressed than in the *ignita* Illig. of Fall. Elytra oval, convex, one-third wider at base than thorax, sides broadly curved, umbones evident but feeble, disk rather closely and relatively coarsely punctate, the punctures behind the umbones plainly seriate in arrangement. Abdomen finely and sparsely punctate, more closely and rugosely in female, the hind margin of each segment fimbriate with fine grayish hairs; hind femora finely pubescent. Last ventral of male with a distinct but small U-shaped emargination at tip which, when held in certain positions, has the appearance of a small rounded fovea. Length, 3-3.3 mm.

Marion Co., Ind., August 3, September 6, three specimens; Lawrence Co., May 11. The ones from Marion Co. were taken by sweep-

^{6a} Since this paper went to press there has appeared in *Psyche*, XXVII, 1920, pp. 101-111, one by Mr. Fall entitled: "On Certain Species of *Haltica*, Old and New." In this he states that the *H. ulmi* of Woods is a synonym of *H. carinata* Germ., and that the *rosa* of Woods is "exceeding close, it actually distinct" to what he (Fall) recognizes as the typical *ignita* Illig. This latter form, he says, occurs in the Eastern States on laurel and was described as *H. kalmia* by Melsheimer. Fall describes four new species in the paper cited, two, *purpurea* and *blanchardi*, from Massachusetts, *heuchera* from Manitoba and *vialis* from New Mexico and Arizona.

ing the foliage of shrubs along the lower edge of a densely wooded slope leading down to the banks of White River. The reddish-purple color, different relative length of joints 2, 3 and 4 of antennæ, the much coarser and seriate post-umbonal punctures and the very different last ventral of male form a group of characters separating *gloriosa* from any others heretofore named from this country.

***Haltica viatica* new species.**

Elongate-oblong, moderately convex. Head and thorax with a brassy tinge, elytra purple, antennæ, legs and under surface blackish-bronzed. Head not tuberculate, the frontal carina prominent. Joints 3 and 4 of antennæ subequal, each one-third longer than second. Thorax one-third wider than long, sides feebly curved, hind angles rounded, front ones without a nodule; disk minutely alutaceous, without evident punctures, its basal impression a narrow, deep, sharply defined groove, terminating each side about one-fifth from margin. Elytra conjointly oblong, very little wider at base than thorax, their sides parallel from behind the very feeble humeri to apical fourth, then rounded into tips; umbones prominent, their limiting depression within scarcely evident; disk finely, sparsely and evenly punctate. Abdomen finely and rather closely punctate, pubescent. Last ventral of male with a median groove extending from apex three-fourths to base and widening posteriorly. Length, 3.2 mm.

Lake Co., Ind., October 6. Judging from Horn's description, it is evidently allied to *tombacina* Mann., from Montana and Alaska, but is smaller, more oblong, with antennal joints 3 and 4 equal and groove of thorax deep and sharply defined.

***Haltica litigata* Fall.**

This species, confused with others in the "Coleoptera of Indiana" under the name *H. ignita* Ill., seems to have a wide distribution. It was described⁷ from Enterprise, Fla., and specimens are at hand from Lake, Vermillion, Vigo, Marion and Martin Cos., Ind. In this State it occurs mainly on the water purslane, *Ludwigia palustris* Ell. From the blue form heretofore commonly known as *H. ignita* Ill., it may be distinguished by its much more protruding eyes and brown tibiæ and tarsi.

***Haltica corni* Woods.**

Two specimens, one of which was identified for me by Mr. Fall as the species here named, are at hand from Indiana. One was

⁷ Trans. Amer. Ent. Soc., XXXVI, 1910, 154.

taken in Crawford Co., June 2, the other in Clark Co., September 16. It is a bluish-black oblong species with the upper surface almost devoid of visible punctures.

Luperaltica fuscata Lec.

A single specimen, the only one known from the State, was taken while sweeping in Posey County, September 22, 1918. It was described⁸ from Pennsylvania, Illinois and Kansas as a *Malacosoma*. Horn treats it fully in his "Galerucini of Boreal America,"⁹ as the genus *Luperaltica* Crotch, seems to be a sort of connecting link between the tribes Halticini and Galerucini.

Luperaltica senilis Say.

This species occurs quite frequently in Marion Co. in early autumn, on the flowers and foliage of the white snake-root, *Eupatorium ageratoides* L., along the lower levels of a densely wooded slope near White River. Elsewhere in the State it is known only from Putnam County.

Lactica iris Oliv.

Only two specimens of this handsome little Halticid are known from the State. The second one was taken August 31 in Marion Co. on the same wooded slope as the preceding.

Sphæroderma opima Lec.

My first Indiana specimen was taken in Marion County, September 8, 1918, the second on September 6, 1920. Several others have been seen in the sweeping net, but as they can jump three feet high they readily escaped capture. In form this is the most rotund and convex of our Halticids, and the hind femora the most incrassate of any. Like many others of the tribe it frequents the foliage of plants growing in low, moist situations. Horn gives its known distribution as Illinois, North Carolina and Texas.

Chætocnema subcylindrica Lec.

The first and only known Indiana specimen of this easily distinguished northern form was taken in Marion County, May 5, 1918. Its range is given by Horn as Massachusetts to Pennsylvania, Michigan, Wyoming and British Columbia.

⁸ Proc. Acad. Nat. Sci. Phil., 1865, 206.

⁹ Trans. Amer. Ent. Soc., XX, 1893, 135.

Systema plicata new species.

Elongate-oblong, subdepressed. Dull yellow, feebly shining; a line behind the eye, wide margins of thorax above and beneath, narrow margins of elytra their full length and epipleuræ piceous-black; apical halves of all the joints of antennæ piceous; basal joint wholly piceous. Head alutaceous, coarsely and sparsely punctate. Thorax subquadrate, one-third wider than long, sides almost straight, parallel; disk alutaceous, coarsely and densely punctate. Elytra one-third wider at base than thorax, humeri rounded; sides parallel to apical sixth, then rounded into apex; disk very coarsely and densely punctate, its sides with a strong plica or fold extending from each humerus almost to apex. Under surface and legs smooth. Male with last ventral slightly impressed at middle of base. Thorax of female with a very feeble transverse sub-basal depression, no trace of which is evident in the male. Length, 3.1-3.5 mm.

Two specimens were swept from low herbage near Half-Moon Pond, Posey County, September 22, 1918. Allied to *S. marginalis* Illig., but smaller, more yellowish in hue, with black markings more pronounced; sides of thorax much less curved, punctuation of upper surface very much coarser and denser, and elytra with a prominent submarginal fold which is wholly lacking or very faint in *marginalis*. It is probably a member of the Austroriparian fauna, as the Lower Austral Life Zone overlaps the Upper Austral in Posey County.

Genus **Tanygaster** new genus.

Oval, convex. Antennæ half as long as body, 11-jointed, joints 2, 3 and 4 subequal, each two-thirds the length of 4-11, which are also subequal in length but gradually a little stouter. Head inserted in thorax to eyes, its frontal carina between the antennæ prominent. Thorax subquadrangular, without basal impression, its hind angles rounded. Elytra but slightly wider at base than thorax, widest at middle, their punctuation confused. Front coxæ narrowly separated, their cavities closed behind. Prosternum finely carinate between the coxæ. Metasternum with median portion thickened, divergent behind. Ventral segments one and five exceptionally long, each one-third longer than 2, 3 and 4 united, these being very short and subequal in length. Hind femora very much inflated. Hind tibiæ with a very fine terminal spur on inner side. Tarsi all very short, basal joint very stout, densely hairy beneath, as long as the others united, third joint strongly bilobed beneath; tarsal claws divergent, feebly appendiculate.

The single species described below, which is the genotype, has somewhat the form and aspect of *Dibolia* or *Psylliodes*. By Horn's table¹⁰ it would run to his group *SYSTEME*, but it is very different in form, length of abdominal segments, etc., from any member of the genus *Systema*.

Tanygaster ovalis new species.

Elongate-oval, rather strongly convex. Black, shining; four outer joints of antennæ fuscous, all the femora fusco-piceous; remainder of antennæ, tibiæ and tarsi dull yellow. Head with a few small punctures between the eyes. Thorax one-half wider than long, its sides regularly curved and rounded into base; front angles each with a small oblique nodular prominence; disk finely alutaceous, evenly, sparsely, rather finely and shallowly punctate. Elytra elongate-oval, their sides feebly curved from base to middle, thence nearly straight and evidently converging to apical fifth, then rounded into tips, the sutural angle of each distinct; disk rather finely, densely and very confusedly punctate. Abdomen and hind femora minutely and sparsely punctate, each puncture bearing a very fine prostrate hair. Last ventral of male with a median oblong elevated area which is broadly emarginate behind; of female with a deep median lengthwise groove which is widened posteriorly. Other characters as given under the generic heading. Length, 2.1-2.3 mm.

Two specimens taken singly in Marion County, June 6, 1912, and May 5, 1918, by sweeping in low moist grounds along the base of a wooded ridge, from which many springs emerge to flow into White River.

NEW SPECIES OF NEMATINAE—(HYMENOPTERA.)

By ALEX. D. MACGILLIVRAY,

URBANA, ILL.

The adults of the following new species are the result of an extended series of collecting and breeding of saw-fly larvæ by Dr. H. Yuasa at Ithaca, New York and by the Maine Agricultural Experiment Station at Orono, Maine. The descriptions of the adults are published at this time in order that the names can be used with descriptions of the larvæ.

Amauronematus vanus new species.

Female.—Body black with the following parts yellowish white: head except postocellar area, extending onto occiput and ocellar basin in part, antennæ for

¹⁰ Trans. Amer. Ent. Soc., XVI, 1889, 167.

most part distad of pedicel, pronotum broadly, tegulae, margins of lobes of mesonotum, cephalic portion of mesoscutellum, dorsal half of pleurae, legs except fuscous ring on metatibiae and fuscous metatarsi, and abdomen for most part; clypeus, labrum, collar, tegulae, and proximal portions of legs paler, other parts more reddish; clypeus slightly roundly emarginate; median fovea inconspicuous, broad slightly depressed area; frontal crest broad, short, transverse, not elevated; ocellar basin not sharply defined, extending around median ocellus; antennae with third and fourth segments subequal, fifth slightly shorter; head and thorax dull; wings hyaline; veins, costa, and stigma yellowish; saw-guides with dorsal margin concave, ventral margin convex, distal portion convexly rounded, oblique, bluntly pointed. Length, 6 mm.

Habitat: Orono, Maine. Sub. 133.

This species belongs near *fulvipes* Nort., but is differently colored.

Amauronematus visendus new species.

Female.—Body black with the following parts white: clypeus, labrum, mandibles, genal orbits, extending onto adjacent orbits, supraclypeal area, pronotum on each side with a central black area, and trochanters; following parts rufous: occipital and vertical orbits, prothoracic and mesothoracic legs beyond middle of femora, basal plates except at middle, and abdomen except caudal segment and saw-guides; clypeus narrowly shallowly emarginate; median fovea an elongate pit; frontal crest not definite, slightly broken by extension from median fovea; ocellar basin a general depression ventrad of median ocellus, lateral walls obsolete; antennae with third segment distinctly shorter than fourth, fourth slightly longer than fifth; head and thorax not polished; metapostscutellum polished; wings slightly infuscated; veins and costa blackish, stigma reddish; saw-guides with dorsal margin straight, ventral margin straight, and converging, distal end oblique. Length, 7 mm.

Male.—Body black with following parts white: clypeus, labrum, genal orbits, mandibles, distal portion of profemora and mesofemora, and protibiae and mesotibiae in great part; small rufous spot on vertical orbits; procidentia minute, convex, rounded. Length, 6 mm.

Habitat: Orono, Maine. Subs. 16, 29.

This species runs to *luteotergum* Nort. The form of the clypeus and frontal crest will differentiate it from this species.

Amauronematus vacivus new species.

Male.—Body black with the following parts yellowish white, inclining to white: head entirely except area included between antennal furrows, extending to frontal crest and expanded upon occiput, pronotum, tegulae, spot on each side of median lobe of mesonotum, pleurae, margins of mesoscutellum, legs except slightly infuscated metatarsi, venter of abdomen, spots on sides of terga, inclining to reddish, larger on caudal segments; clypeus slightly narrowly emarginate, almost truncate; median fovea a minute pit; frontal crest not

sharply defined, unbroken; ocellar basin represented by a slight depression on ventral side of median ocellus, lateral walls obsolete; head and thorax polished, setaceous; antennæ with third, fourth, and fifth segments subequal; wings hyaline; veins fuscous, stigma and costa whitish; procidentia very long, with parallel sides, rounded. Length, 6 mm.

Habitat: Orono, Maine. Sub. 61.

This species differs from *similis* Marl. in the form of the frontal crest and the color of the head.

Amauronematus verbosus new species.

Female.—Body yellowish white shading to rufous, with the following parts black: antennæ, irregular area surrounding ocelli and covering ocellar basin, spot on dorsal side of each antecorion, spots on lobes of mesonotum, caudal half of mesoscutellum and of mesopostscutellum, metascutellum in great part, mesosternum, spot on coxæ, proximal portion of femora, largest on metafemora, metatibiæ, metatarsi, basal plates, cephalic part of first abdominal tergum, and saw-guides; antennæ with third segment shorter than fourth, fourth and fifth subequal; median fovea obsolete; frontal crest a narrow shield-shaped, not strongly elevated area, unbroken; ocellar basin limited by sides of frontal crest, lateral walls wanting; wings slightly infuscated; veins, stigma, and costa yellowish, veins on proximal half of wing darker; saw-guides large, stout, dorsal margin straight, ventral margin convex, distal end truncate. Length, 7.5 mm.

Habitat: Orono, Maine. Sub. 162.

This species differs from *luteocergum* Nort. in the form of its median fovea.

Amauronematus venaticus new species.

Male.—Body black with the following parts yellowish white: clypeus, labrum, mandibles, mouth-parts, supraclypeal area, genal orbits, extending onto adjacent orbits, collar, tegulæ, and legs except proximal ends of coxæ, distad of middle of femora, particularly the metathoracic legs, inclined to reddish; occipital, vertical, and frontal orbits reddish; clypeus broadly, shallowly emarginate; median fovea broad, shallow, indistinct; frontal crest narrow, only slightly raised, not prominent; ocellar basin flat, lateral walls elevated, but not above ocellar basin; antennæ with third and fourth segments subequal, fourth slightly longer than fifth; head and thorax polished; wings hyaline; veins, stigma, and costa pale; procidentia broad, hardly differentiated; caudal margin of caudal sternum slightly emarginate. Length, 5 mm.

Habitat: Orono, Maine. Sub. 6.

This species differs from *azaleæ* Marl. in the coloration of head and abdomen.

Amauronematus vescus new species.

Female.—Body black with the following parts yellowish white: supra-clypeal area, clypeus, labrum, mandibles, mouth-parts, genal orbits, extending onto frontal orbits, vertical orbits, occipital orbits, collar, band on lateral margin of abdominal segments one to six, sometimes extending over all of their terga and sterna, and caudal tergum; trochanters, prothoracic and mesothoracic legs, beyond middle of femora, rufous; clypeus narrowly, shallowly emarginate; median fovea longer than broad, deep, sides sloping; frontal crest slightly broken, narrow, not elevated; ocellar basin hardly distinguishable, lateral walls obsolete; antennæ with third, fourth, and fifth segments subequal; head and thorax not polished; wings slightly infuscated; costa, stigma, and veins of distal half rufous, veins of proximal half black; saw-guides robust, dorsal margin straight, ventral margin convex, distal portion oblique, pointed. Length, 8 mm.

Habitat: Orono, Maine. Sub. 112.

This species differs from *gracilis* Marl. in the length of the third antennal segment.

Amauronematus venerandus new species.

Male.—Body black with the following parts infuscated yellowish: prothoracic and mesothoracic legs beyond proximal third of femora, metathoracic legs beyond tibiæ, caudal aspect of femora more or less pale, and caudal abdominal sternum; clypeus distinctly, roundly, deeply emarginate; median fovea obsolete; frontal crest almost obsolete; ocellar basin a narrow, elongate depression extending from dorsad of median ocellus onto supra-clypeal area, lateral walls rounded, hardly elevated; antennæ with third segment slightly shorter than fourth, fourth and fifth subequal; mesoscutellum polished; wings hyaline; veins, stigma, and costa brownish; procidentia narrow, short, rounded, convex. Length, 4.5 mm.

Habitat: Orono, Maine. Sub. 27.

This species runs in Marlat's tables to the species of *Amauronematus* to *borealis*.

Pachnematus rarus new species.

Female.—Body black with the following parts yellowish white: supra-clypeal area, clypeus, labrum, mandibles, mouth-parts, genal orbits, pronotum, tegulæ, oblique mark on pleuræ, legs, venter of abdomen, and caudal tergum; following parts rufous: occipital, vertical, and frontal orbits, margins of median lobe of mesonotum faintly, mesoscutellum faintly, and caudal abdominal terga more or less; yellowish white of abdominal sterna sometimes extending onto lateral portions of terga; clypeus distinctly but shallowly, roundly emarginate; median fovea rather indefinite, broad and shallow; frontal crest not distinct, broken, narrow; ocellar basin flat, lateral limiting walls rounded, identifiable but rather indefinite; antennæ with third, fourth, and fifth seg-

ments subequal; head and thorax polished; wings hyaline; veins, costa, and stigma pale; saw-guides stout, broad, dorsal margin straight, ventral margin convex, distal portion convex and oblique, pointed above. Length 4.5 mm.

Habitat: Orono, Maine. Sub. 229.

This species differs from *gregarius* Marl. in the form of its frontal crest.

Pachynematus roscidus new species.

Female.—Body black with the following parts yellowish: labrum, mandibles, collar, tegulae, legs except distal portion of metatibiae and metatarsi, venter of abdomen except first and caudal sterna and saw-guides, caudal tergum, and narrow bands on caudal margin of other terga; occipital and vertical orbits faintly rufous; clypeus narrowly emarginate, lateral angles broadly rounded; median fovea deep, longer than broad, pit-like; frontal crest narrow, linear, unbroken; ocellar basin limited by distinct linear, elevated, lateral walls, surface flat; head and thorax setaceous; head not dilated behind compound eyes; antennae with third segment longer than fourth and fourth longer than fifth; wings hyaline; veins, stigma, and costa, except proximal and distal portions, brownish; saw-guides stout, dorsal margin straight to slightly concave, ventral margin convex, distal portion oblique. Length, 6.5 mm.

Habitat: Adirondack Mountains, C. O. Houghton, collector; Orono, Maine, Sub. 227.

This species is related to *robustus* Marl.

Pachynematus repertus new species.

Female.—Body black with the following parts yellowish white: supra-clypeal area, clypeus, labrum, mandibles, mouth-parts, pronotum, tegulae, legs except distal one-third of metafemora, distal one-half of metatibiae, and metatarsi, abdominal sterna except caudal one, and caudal abdominal tergum in great part; pale parts of head and caudal tergum whiter than other pale parts; clypeus narrowly, roundly, comparatively deeply emarginate; median fovea elongate, about three times as long as broad, shallow; frontal crest narrow, not prominent, unbroken; ocellar basin distinct, depressed, shallow, polished fovea ventrad of median ocellus, limiting lateral walls distinct, linear; head and mesonotum setaceous; mesoscutellum glabrous and polished; wings hyaline; stigma and veins brownish, costa yellowish; saw-guides with dorsal margin straight and oblique, ventral margin convex, distal portion bluntly convexly rounded. Length, 6 mm.

Habitat: Ithaca, New York. No. 177-1-2.

This species differs from *palliventris* Cress. in the form of its median fovea.

Pachynematus refractarius new species.

Female.—Body luteous with the following parts black: antennae, spots on median and lateral lobes of mesonotum, round dot on caudo-mesal angle of

each lateral lobe of mesonotum, mesopostscutellum in part, abdominal terga one to four irregularly on meson, ring on metatibiæ, and distal half of metatarsi; antennæ with fourth segment longer than third and fifth segments; clypeus deeply, narrowly, roundly emarginate, median fovea shallow, broad, not well defined; frontal crest narrow, indefinite, broken; ocellar basin flat, depressed, lateral walls rounded, not sharply defined; head and thorax polished; wings infuscated or brownish; veins brownish, stigma and costa luteous; saw-guides with dorsal margin straight, ventral margin straight, converging caudad, distal portion convexly bluntly rounded, pointed above. Length, 8 mm.

Habitat: Orono, Maine. Sub. 252.

This species belongs in the group with *suadus* Cress., *affinis* Marl., and *rufocinctus* MacG. Color, form of median fovea, and frontal crest will distinguish them.

Pachynematus remissus new species.

Female.—Body black with the following parts whitish: margin of clypeus, labrum, mandibles, collar, tegulæ, coxæ except at proximal end, trochanters, proximal and distal ends of profemora more or less, protibiæ, mesotibiæ, proximal one-fourth of metatibiæ, probasitarsi, mesobasitarsi, and venter of abdomen except caudal sternum, extending onto lateral portions of terga; clypeus broadly shallowly emarginate, almost truncate; median fovea deep, broad; frontal crest not prominent, distinct, linear, dorsal margin three-sided; ocellar basin depressed, distinct, lateral walls distinct, linear; antennæ with third segment longer than fourth and fourth slightly longer than fifth; head and thorax setaceous; wings hyaline; veins and stigma brownish, costa pale; saw-guides stout, dorsal margin straight, ventral margin straight, oblique, distal end blunt. Length, 7 mm.

Habitat: Ithaca, New York. Nos. 150-3, 150-1, 150-1-1.

This species differs from *palliventris* Cress. in the form of its median fovea, frontal crest, and ocellar basin.

Pontania dedecora new species.

Female.—Body black with the following parts luteous: head except small area around each ocellus, pronotum, tegulæ, and legs except metacoxæ in part, fuscous ring on metatibiæ, and distal half of metatarsi; clypeus deeply narrowly emarginate; antennæ with third segment longer than fourth and fourth longer than fifth; median fovea shallow, broad, continuous with ocellar basin; frontal crest indefinite; ocellar basin distinct, lateral walls linear, closed caudad of median ocellus; head and thorax not polished; wings hyaline; veins and distal half of stigma brownish, proximal half and costa pale; saw-guides with dorsal margin straight, oblique, ventral margin convex, distal portion concave, pointed above. Length, 4.5 mm.

Habitat: Ithaca, New York. Nos. 185a2, 8.51(?)—1-1.

This species differs from *pallicornis* Nort. in the coloration of the head.

Pontania decrepita new species.

Female.—Body black with the following parts yellowish white: clypeus, labrum, mandibles, mouth-parts, line on collar, tegulae, and legs; abdomen, particularly the caudal portion, rufous; clypeus broadly shallowly emarginate; median fovea shallow, broad, continuous with ocellar basin; frontal crest except at sides, obsolete; ocellar basin distinct, concave, lateral walls distinct, rounded, polished, open between ocelli; antennae with third segment slightly longer than fourth and fourth slightly longer than fifth; head and thorax polished; wings hyaline; veins, stigma, and costa concolorous and pale; saw-guides stout, dorsal margin concave, ventral margin convex, distal portion strongly oblique, pointed above. Length, 3 mm.

Habitat: Ithaca, New York. No. 35-2-5.

This species differs from *terminalis* Marl. in the form of its saw-guides.

Pontania demissa new species.

Female.—Body black with the following parts yellowish rufous: clypeus, labrum, supraclypeal area, mandibles, mouth-parts, genal orbits, occipital and vertical orbits broadly, frontal orbits narrowly, collar, tegulae, legs except proximal portions of coxae, venter of abdomen, and caudal abdominal tergum; clypeus shallowly narrowly emarginate; median fovea an elongate, shallow depression continuous with ocellar basin; frontal crest represented only as an indefinite portion of lateral boundary of ocellar basin; ocellar basin flat, depressed, lateral walls distinct, rounded, open between ocelli; antennae with third segment slightly longer than either of the subequal fourth and fifth segments; wings hyaline; veins, costa, and stigma concolorous and pale; saw-guides with dorsal margin straight, ventral and distal margins obliquely, convexly rounded, bluntly pointed above. Length, 4 mm.

Habitat: Ithaca, New York. No. 191-1-1.

This species can be recognized through the absence of the frontal crest.

Pontania dædala new species.

Female.—Body black with the following parts yellowish white: labrum, mandibles, mouth-parts, genal orbits, tegulae, and legs except proximal portions of coxae; clypeus broadly slightly emarginate; median fovea broad, circular, sloping sides, deep at center; frontal crest not prominent, transverse, not broken, linear between ocellar basin and median fovea; ocellar basin, an oval area surrounding median ocellus, deep, longer than broad, lateral walls rounded, indistinct; third segment of antennae longer than fourth, fourth slightly longer than fifth; head and thorax dull, setaceous; wings hyaline;

veins, costa, and distal half of stigma pale, proximal half of stigma fuscous; saw-guides with dorsal and ventral margins slightly convex, strongly converging, pointed. Length, 4 mm.

Habitat: Ithaca, New York. No. 7-6.

This species is similar to *hyalina* Nort. from which it can be distinguished by the color of the pronotum.

Pontania devincta new species.

Female.—Body black with the following parts yellowish white: margin of clypeus, labrum, mandibles, mouth-parts, dot on supraclypeal area, pronotum, tegulæ, legs except greater part of metacoxæ; clypeus broadly, deeply, roundly emarginate; median fovea broad, round, shallow; frontal crest narrow, not sharply defined, slightly broken; ocellar basin indistinct, lateral walls rounded, indefinite; antennæ with third segment longer than fourth, fourth slightly longer than fifth; head and thorax dull, setaceous; wings hyaline; veins, stigma, and costa luteous; saw-guides with dorsal and ventral margins straight, strongly converging, distal end sharply pointed. Length, 4 mm.

Male.—Body black with following parts yellowish white: antennæ, supraclypeal area, between antennæ, clypeus, labrum, mandibles, mouth-parts, genal orbits, ventral half of frontal orbits, occipital orbits, vertical orbits, collar, tegulæ, legs, and venter of abdomen; procidentia broad, rounded, not strongly convex; other structures as in female. Length, 3.5 mm.

Habitat: Orono, Maine. Subs. 9, 226.

This species can be separated from *borcalis* Marl. by the difference in the frontal crest.

Pontania derosa new species.

Female.—Body black with the following parts yellowish white: supraclypeal area, clypeus, labrum, mandibles, collar, tegulæ, and legs except proximal two-thirds of coxæ; occipital and vertical orbits narrowly rufous; antennæ with third, fourth, and fifth segments subequal; clypeus broadly, rather deeply emarginate; median fovea circular, concave depression extending dorsad from it to frontal crest; frontal crest indistinct, rounded, broken; ocellar basin comparatively distinct, depressed, lateral walls linear, not strongly elevated; head and thorax not polished; wings hyaline; veins brownish, costa and proximal half of stigma pale, distal half strongly infuscated; saw-guides with dorsal margin straight, ventral margin convex, distal portion concave, distal end pointed. Length, 4 mm.

Habitat: Ithaca, New York. No. 142-1-1.

This species differs from *nigrita* Marl. in the color of its orbits.

Pontania dotata new species.

Male.—Body black with the following parts yellowish white: clypeus, labrum, mandibles, supraclypeal area, between antennæ to frontal crest, mouth-

parts, all orbits broadly, pronotum entirely, tegulae, mesopleurae, cephalic portion of mesosternum, legs entirely, and venter of abdomen, extending slightly onto lateral parts of terga; clypeus narrowly, roundly, deeply emarginate; median fovea deep oval pit; frontal crest sharp, well marked, linear, transverse, unbroken; ocellar basin depressed, flat, limited by linear walls; antennae with third and fourth segments subequal, fifth segment shorter; head and thorax setaceous, polished; wings hyaline; veins brownish, stigma and costa paler; procidentia small, rounded, not longer than wide.

Habitat: Ithaca, New York. No. 8,480 (?)—1—1.

This species should be placed near *populi* Marl., but the color of the head and the length of the antennal segments will separate them.

LINYPHIIDAE OF ST. PAUL ISLAND, ALASKA.

BY RALPH V. CHAMBERLIN.

CAMBRIDGE, MASS.

While on St. Paul Island in 1910 Professor Harold Heath collected and sent to me the spiders here listed. They compose an interesting lot in which all the specimens belong to the family Linyphiidae. Ten species are represented, of which four are new, two of these being here made the types of genera. The previously known species are forms occurring on the adjoining mainland of North America or Asia, or on both. *Arctilaira bellans* new species (= *Hilaira glacialis* Kulczynski, nec Thorell) is an Arctic form occurring across Arctic America and Siberia, the present being its most southerly record. A new North American genus related to *Arctilaira* is also here described. All types are in the author's collection.

Cornicularia clavicornis Emerton.

Trans. Conn. Acad., 1882, 6, p. 43, pl. 8, f. 7-7b.

One male and one female.

Erigone sibirica Kulczynski.

Mem. Acad. Imp. Sci., St. Petersburg, 1908, ser. 8, 18, p. 18, pl. 1, f. 9-12.

This species, to judge from the number of specimens in the lot, must be a common form on the island. The palpal organ of the males agrees completely with Kulczynski's description and figures. The

epigynum of the females, as noted by Kulczynski, is very close in form to that of *E. arctica* (White). The epigyna of the specimens from St. Paul Id., agree in their larger proportions with those of the typical Siberian specimens.

Ædothorax septentrionalis Kulczynski.

Gongylidium septentrionalis, Op. cit., p. 14, pl. I, f. 18.

Several females.

Ædothorax nesides new species. Plate III, figs. 1, 2.

Male.—Carapace black or nearly so, the lighter ground color showing but weakly, the sternum similar. Legs fulvous. Palpus fulvous excepting the tarsus, which is blackish. Cephalothorax high; in side view it is seen to rise obliquely from eye area, then to become nearly horizontal to beginning of the posterior declivity. Clypeus slanting forward a little from eyes to lower margin, the latter in dorsal view appearing weakly convex; in height equalling the length of the median eye area. Posterior row of eyes slightly procurved; eyes equal and equidistant or very nearly so, the interval between each two being equal to the diameter of an eye. Anterior row of eyes with medians much smaller than the laterals, their diameters being to each other about as 2.5:4. Upper margin of furrow of chelicera with three large teeth, lower margin with five minute teeth. Palpal organ with embolus curving across end of bulb from mesal side to ectal and then back, its distal portion resting on the prominently exposed guide much as in, e.g., the European *Æ. agrestis*. For paracymbium and other details see fig. 1. Tibia with a single simple broad process above which at tip curves slightly ectad. See fig. 2.

Length of cephalothorax, 1 mm.; width, .8 mm. Length of tib. + pat. II, .8 mm.

Genus ***Aigola*** new genus.

Tibia of male palpus wholly lacking processes. Cymbium with ectal margin incised toward distal end, forming a small lobe. Paracymbium large, curved, shortly and singularly more or less expanded or furcate at distal end and with a spur at base. Tegulum a broad, strongly chitinous plate lying along the mesal side of the retracted organ and curving ectad to the middle. Ectad of its mesal end is a membranous lobe which projects freely distoëctad. At distal end of bulb a short, strongly chitinous, weakly curved apophysis. Embolus not exposed. Posterior row of eyes (males) straight or a little recurved; median eyes nearer to each other than to the laterals. Anterior row of eyes a little recurved, the median eyes smaller than the laterals and much closer together than to the latter. Clypeus high.

GENOTYPE.—*A. pauliana* n. sp.

Includes also *A. tuberella*, nom. nov. pro *Gongylidium tuberosum* Em., preoccupied by *G. tuberosum* (Blackwall).

Aigola pauliana new species. Plate III, figs. 3, 4.

Male.—Carapace dusky over fulvous, appearing brown. Sternum more fulvous, darker about margins. Legs like sternum. Abdomen black. Head gently convexly rising behind eyes. Posterior row of eyes straight or very slightly procurved; the medians in the type are slightly more (about one eighth) than their diameter apart, and between 1.4 and 1.5 times their diameter from the laterals; slightly smaller than the laterals. Anterior row of eyes recurved; median eyes close together, less than their radius apart, a little more than their diameter (eleven and one seventh) from the laterals, smaller than the latter, the ratio of diameters being about as 7:10. Clypeus three times higher than the diameter of a lateral eye and considerably higher than length of median eye area. Area of median eyes a little longer than wide (12:11) and wider behind than in front in ratio 11:8. Upper margin of the furrow of chelicera bearing six teeth, a very small one appearing at distal end of series as it is present in *tuberella* and one at proximal end which is large though smaller than the adjacent one. Details of the palpal organ are shown in the figs. 3 and 4.

Length, 3.2 mm.

Length of cephalothorax, 1.57 mm.; width, 1.16 mm.

Length of tib. + pat. I, 1.55 mm.; of tib. + pat. IV, 1.6 mm.

Length of tib. I, 1.35 mm.; of tib. IV, 1.42 mm.

Aigola tuberella new name. Plate III, figs. 5, 6.

Gongylidium tuberosum Emerton, Trans. Conn. Acad., 1915, 20, p. 150, Pl. 5, figs. 5-56.

Male.—Posterior row of eyes a little recurved. Eyes larger and nearer together than in *pauliana*, the medians about three-fifths their diameter apart, and 1.4 times their diameter from the laterals. Anterior row of eyes very slightly recurved; median eyes smaller than laterals in about ratio 9:11 or 4:5, nearly their radius apart and one and one-fourth their diameter from the laterals. Clypeus about three and one-half times as high as diameter of an anterior lateral eye. Area of median eyes as broad as long, wider behind than in front in ratio 7:5.

Upper margin of furrow of chelicera with four teeth.

Length of cephalothorax, 2 mm.; width, 1.44 mm.

Length of tib. + pat. I, 1.98 mm. F. of tib. + pat. IV, 2.16 mm. Length of tib. I, 1.59 mm. F. of tib. IV, 1.75 mm.

Locality.—Labrador: Battle Harbor. (C. W. Leng.)

The type is larger than that of *pauliana*, but the cephalothorax and legs agree nearly in proportions. The posterior median eyes are

clearly closer together than in the genotype, as indicated in the description above. A difference to be noted is that only four teeth are present along the upper margin of the furrow of the chelicera as against six in the genotype. The palpal organ differs in the form of paracymbium, as in lacking a ventral prong or lobe at distal end as shown in the figures. It also differs in various other details; e.g., at the distal end of the bulb it has a prominently projecting lobe not obvious as such in *pauliana*, this lying just within the free membranous lobe, as shown in fig. 5, where it is just at the left of the terminal apophysis, and extends distad beyond the other parts.

Genus **Anitsia** new genus.

A genus suggesting *Catabrithorax* in its broad thorax and head, though the latter is more elevated with sides steeper. It also resembles that genus in the structure of the male palpal organ, the median lobe of the bulb giving rise to a similar membranous process which bends forward freely beneath the bulb, though in the present genus this process is broader and shorter, and free for a shorter distance. The median dorsal process of the tibia of the male palpus lacks the characteristic strong curvature of that in *Catabrithorax*. From the latter the genus differs conspicuously in the eyes. Both rows are straight or nearly so. The eyes, instead of being close together, are widely separated. Eyes of posterior row nearly equidistant, separated by clearly more than their diameter, sometimes by much more. Anterior median eyes smaller than the laterals, near to each other but more than their diameter from the laterals. Lateral eyes separated by a narrow space. Area of median eyes trapeziform, longer than wide. Height of clypeus typically a little exceeding the length of the quadrangle of median eyes. Sternum prolonged between the posterior coxæ.

GENOTYPE.—*A. abjecta*, n. sp.

Includes also the Siberian *Erigone mendica* of Koch.

Anitsia abjecta new species. Plate IV, figs. 8–10.

Male.—Carapace and sternum blackish, as is also the abdomen. Legs brownish yellow. Cephalothorax broad, head considerably broader than length of eye rows, much as in *Catabrithorax*. Head moderately high with sides steep. Posterior row of eyes slightly procurved; eyes equidistant, the interval between each two exceeding the diameter of a median eye about as 7:5;

median eyes smaller than the laterals. Area of median eyes longer than wide (10:9), wider behind than in front in the ratio 4:3. Anterior median eyes much smaller than the laterals and much nearer to each other, being about their radius apart but more than their diameter from the laterals. Clypeus a little higher than length of area of median eyes. Upper margin of furrow of chelicera with five large teeth; lower margin with a series of close-set minute teeth situated well toward base of fang. Details of palpus as shown in figs. 8, 9, and 10.

Female.—Epigynum as shown in fig. 7.

Length of cephalothorax of male type, 1 mm.; width, .8 mm.

Length of tib. + pat. I, .8 mm.; of tib. + pat. IV, 1 + mm.

A. mendica (Koch) differs in the more widely separated eyes of the posterior row. The male differs obviously in the characters of the palpus as e.g., in the median dorsal apophysis of the tibia, which is much more slender and has on each side another process of characteristic form.

Genus **Arctilaira** new genus.

Agreeing with *Utopiellum* Strand in the form of the cephalothorax. The latter in the male is similarly depressed between and caudad of the eyes in front of the cephalic elevation. Posterior row of eyes strongly procurved, the eyes widely separated. Lateral eyes prominently elevated on common tubercles. Upper margin of furrow of chelicera with five teeth of which the uppermost is reduced, the lower margin with three small, often granular, teeth, the dentition alike in the two sexes. Chelicera of male not armed in front. Metatarsi of leg I in the male curved and strongly spined. Tibia of male palpus much thicker than patella, enlarged distad, at distal end above with a very prominent prolongation above the tarsus. Third division of bulb with a prominently elevated and more or less complicated lobe which extends to or beyond the tip of the cymbium. Epigynum short and broad, not prolonged freely behind the epigastric furrows.

GENOTYPE.—*Arctilaira bellans* sp. nov.

The genus is quite obviously nearest *Utopiellum* (Strand, 1901), which was established with the *Erigone mirabilis* of Koch as genotype, but in the structure of the copulatory organs in particular is quite distinct. In *Utopiellum* the terminal lobe of the bulb of the male palpus, so conspicuously developed in *Arctilaira* and *Hilaira*, is obsolete, thus leaving the distal part of the alveolus empty and freely exposed; while there is present across the distal end of the bulb and

curving freely distad from its outer edge a conspicuous, smooth, distally acuminate blade. The females of *Utopicellum* have the epigynum elongate and narrowed caudad and prolonged much behind the epigastric furrow. In addition to the genotype, the *Gongylidium curvitaris* of Emerton belongs clearly to this genus and will accordingly stand as *Utopicellum curvitaris* (Emerton).

Arctilaira bellans new species.

Hilaira glacialis Kulczynski (nec Thorell 1871), Mem. Acad. Imp. Sci. St. Petersburg, 1908, 18, no. 7, p. 25, pl. 2, f. 45, 48, 49.

A male and several females of this Arctic species, which has a distribution across Siberia and Arctic America. It is the form described by Kulczynski in the place above cited under the name *Hilaira glacialis*, but is apparently not the *Hilaira glacialis* of Thorell according to the description of a male of this species given by Simon.¹

Tmeticus armatus Banks.

Proc. Ent. Soc. Wash., 1906, 7, p. 98.

One female.

Genus **Montilaira** new genus.

Cephalothorax suggesting that of *Arctilaira*, but the tubercles of the eyes less prominent and the median depression in front of the postocular elevation less marked. Posterior row of eyes straight, the eyes well separated, the medians nearer to each other than to the laterals. Upper margin of furrow of chelicera armed with five large teeth, the lower margin with five minute teeth, alike in male and female. Chelicera of male armed in front. Metatarsi of all legs unarmed in both sexes. Tibia of each leg of the first three pairs typically armed above with two spines, that of each fourth leg with but one. Palpus of male with tibia enlarged as in related genera, its dorsal distal margin extended only as a short wide plate or lobe which may be angulate or toothed or not. Bulb characterized especially by the presence of a median apophysis which is strongly pectinate on ventral surface and especially along mesal edge, this apophysis lying against the conductor and its marginal teeth protecting the embolus. Epigynum in form of a strongly chitinized plate turned forward from posterior border and presenting its free edge cephalad.

¹ Bull. Mus. Hist. Nat., 1908, p. 505.

GENOTYPE.—*Hilaira uta* Chamberlin.

Differs from *Hilaria* sens. str., in the possession of five minute teeth along lower margin of furrow of chelicera instead of three, the presence of a single spine only above on tibia IV instead of two, the presence of an anterior process on chelicera of male, the much less developed dorsal distal lobe of the tibia of male palpus and particularly the structure of the bulb of the palpus. In the arrangement of eyes very similar to *Hilarotes* (Hull, 1909), though the lateral eyes of the latter are not on tubercles and the middle region of the head in front of elevated region is not depressed. *Hilarotes*, as typified by *reproba* (Cambridge), a species included by Simon in *Hilaira* sens. lat. (Hist. Nat. Araign., I.), is otherwise distinguished in having but three, moderately large, teeth along lower margin of furrow of chelicera, the presence of two dorsal spines on tibia IV, etc.

In addition to the genotype, one other species is known to me at present as belonging to *Montilaira*, this being *Erigone perplexa* Keyserling, of which the *Tmcticus pectinatus* of Emerton seems to be a synonym. The two species are very close in general structure but differ in various details. Thus the males are readily distinguishable by the difference in the anterior dorsal lobe of the tibia of the male palpus, this presenting a conspicuous median tooth in *perplexa* with an angulation each side, whereas the margin is evenly rounded in *uta*, as shown in figs. 12 and 11. The median embayment in the anterior free edge of the epigynal plate is deeper and at bottom broader in *perplexa* than in *uta*. The paired claws (leg I) in *uta* have each typically eight teeth, in *perplexa* but six, etc.

Microneta heathi new species. Plate IV, fig. 13.

Carapace dusky over fulvous, blackish along borders. Legs fulvous. Abdomen blackish. Posterior row of eyes procurved; median eyes larger than the laterals (about 3.7:3), a little more than three-fourths their diameter apart (3:3.7), a little nearer to the laterals. Anterior row of eyes a little procurved, the summits of the eyes forming a nearly straight line; median eyes much smaller than the laterals, the diameters being about as 2.5:4; less than their diameter apart, their diameter from the laterals. Area of median eyes trapeziform, wider behind than in front in the ratio 9:6.5, equal in length and width, or the length slightly greater. Clypeus lower than the width of the median eye area in front. Unpaired claw (first leg) with a single tooth beneath; paired claw with twelve short teeth which increase in length in going distad, the longest of these not quite equalling the diameter of the contiguous

part of the claw. Sternum strongly convex, subtriangular, prolonged behind between fourth coxæ; obtusely angularly excavated in front, extending forward each side of labium, the border of excavated part slanting steeply. Clypeus depressed below the anterior eyes which thus protrude over its upper part from where it slants to the lower margin, which in dorsal view is nearly straight. Upper margin of furrow of chelicera with three well-separated teeth, the lower margin with five very minute teeth in a close-set series the length of which but little exceeds half the length of the upper series. Epigynum large and prominent, as shown in fig. 13.

Length, 1.74 mm.; width, .7 mm.

Length of femur I, .93 mm.; of tib. + pat. I, 1 + mm.; of tib. I, .86 mm.; of met. I, .8 mm.; of tar. I, .63 mm.

Bathyphantes brevipes (Emerton).

Diplostyla brevipes Emerton, Can. Ent., 1917, p. 267, fig. 19, 3, 4 and 8.

Two males and several females.

The species also occurs on Vancouver, Id., the type locality, and on the mainland.

EXPLANATION OF PLATES III AND IV.

PLATE III.

Edothorax nesides n. sp.

Fig. 1. Palpus of male, ectal view.

Fig. 2. Tibia of palpus of male, dorsal view.

Aigola pauliana n. sp.

Fig. 3. Palpus of male, ventral view.

Fig. 4. The same, view a little ventrad of ectal.

Aigola tuberella n. n.

Fig. 5. Palpus of male, view same as in 4.

Fig. 6. Mesal end of paracymbium, mesal view.

Anitsia abjecta n. sp.

Fig. 7. Epigynum.

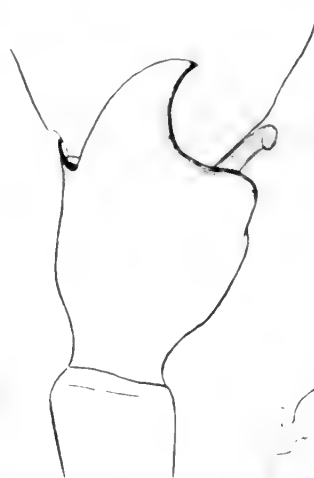
PLATE IV.

Anitsia abjecta n. sp.

Fig. 8. Right palpus of male, ventral view.

Fig. 9. Left palpus of male, ectal view.

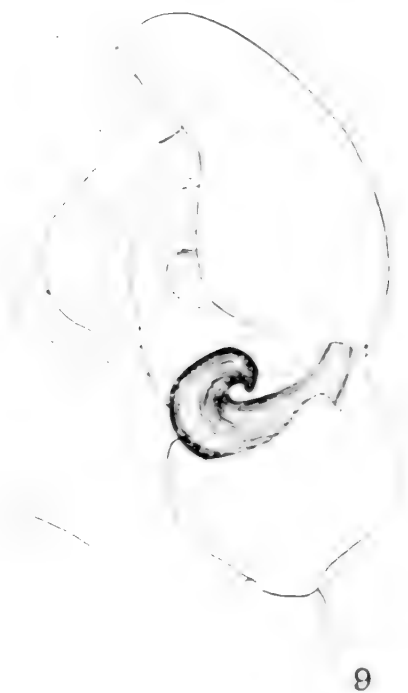
Fig. 10. Tibia of palpus of male, dorsal view.



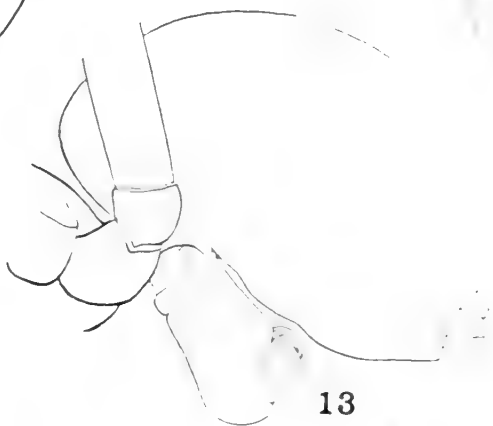
(LIXYPHIDAE.)



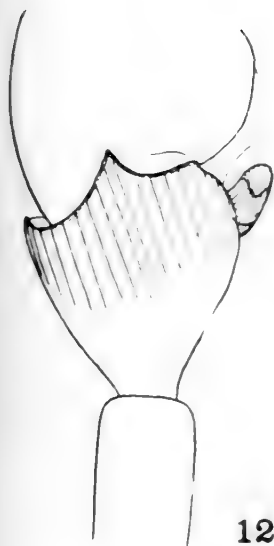
8



9



13



12



10



11

(LIXYPHIDAE.)

Montilaira uta (Chamberlin).

Fig. 11. Tibia of palpus of male, dorsal view.

Montilaira perplexa (Keyserling).

Fig. 12. Tibia of palpus of male, dorsal view.

Microneta heathi n. sp.

Fig. 13. Lateral view of abdomen, with epigynum, of female.

AN ANNOTATED LIST OF THE CICADAS OF COLORADO WITH DESCRIPTION OF A NEW SPECIES.

By WM. T. DAVIS,

NEW BRIGHTON, STATEN ISLAND, N. Y.

In the summer of 1919 the American Museum of Natural History sent a collecting party to Colorado, and among the insects secured by Dr. Frank E. Lutz and his two companions Messrs. Herbert F. Schwarz and Pearce Bailey, Jr., were twelve species of Cicadas. Dr. Lutz has kindly turned these over to me for determination. In the summer of 1920 Dr. Lutz secured an additional species. Prof. Theodore D. A. Cockerell has sent me several species collected in the state, one of which is here described as new, and has also furnished the names of three fossil species. To Prof. C. P. Gillette and Prof. Charles R. Jones of the Colorado Agricultural College, I am indebted for the loan of specimens representing nine species. To these sources of information have been added records made by the writer from specimens in his own collection, or sent to him at various times for determination. These last are acknowledged in connection with the several records.

There are a few species found in the eastern half of Kansas, and also in Nebraska, that do not appear to reach Colorado, but on the other hand some of the recorded species of *Okanagana* probably do not extend eastward of the mountainous regions of the state. Twenty-three species are here recorded, but only two of them, namely *Tibicen linnei* and *Tibicen canicularis*, are of the fauna of the Atlantic states. The majority of the others mentioned are confined

to the central parts of North America, only three or four of the species of *Okanagana* and *Platyptidia* reaching California, and then often showing some variation from Colorado specimens.

Among the several species most likely to be collected in the future in Colorado and thus added to the present list are:

***Tibicen aurifera* (Say).**

Common in Kansas, and recorded from as far west as Seward, near the western part of that state at an elevation of 2,600 feet. This species was figured in the JOURNAL, N. Y. Entomological Society, March, 1916, Pl. 3, fig. 4.

***Tibicen resh* (Haldeman).**

Received from Elk Co., Kansas, 1,008 ft. (R. H. Beamer), and figured in JOURNAL, N. Y. Entomological Society, March, 1915, Pl. 1, fig. 3.

***Tibicen eugraphica* (Davis).**

A very common species in parts of New Mexico; we have a male from Albuquerque, Bernalillo Co., which is within 140 miles of the Colorado line. From 160 miles to the east we have seen eighty males and eleven females collected in Barber Co., Kansas, July 19-21, 1916, 1,468 ft. elevation, by Mr. R. H. Beamer. This species is usually found in dry situations. It was described and figured in the JOURNAL, N. Y. Entomological Society, March, 1916, Pl. 5, fig. 3.

***Tibicen vitripennis* (Say).**

Examined from both Nebraska and Kansas, so may possibly occur in Colorado. Figured in the JOURNAL, N. Y. Entomological Society, March, 1916, Pl. 6, fig. 3.

***Okanagana striatipes* (Haldeman).**

A more western species common in parts of Utah and Arizona, but likely to occur in Colorado as well. This species is considered in the JOURNAL, N. Y. Entomological Society, June-September, 1919, p. 215, and a figure is presented on the plate accompanying the present article.

In 1895 Prof. C. P. Gillette and C. F. Baker published a Preliminary List of the Hemiptera of Colorado, as Bulletin 31, Agricultural Experiment Station, State College of Colorado. They enumerated nine species, namely:

Cicada dorsata Say.

Cicada marginata Say [*Tibicen marginalis* Walker of this list].

Cicada tibicen Linn. [*Tibicen linnei* (S. & G.) of this list].

Proarna valvata Uhler.

Tibicen synodica (Say).

Tibicen rimosa (Say) [*Okanagana bella* Davis of this list].

Tibicen cruentifera Uhler.

Platypedia putnami (Uhler).

Melampsalta parvula (Say) [*M. calliope* (Walker) of this list].

The reasons for dropping *tibicen* Linn. as far as the fauna of the United States is concerned were given by Smith and Grossbeck, Entomological News, XVIII, 1907, and the other two changes are explained by the writer in the June-Sept., 1919, and June, 1920, numbers of the JOURNAL, N. Y. Entomological Society.

While there will ultimately be found just as many or even more species of Cicadas in Kansas than in Colorado, the following remarks on the latter state by Gillette and Baker in their introduction to the list already referred to, seem well justified: "Probably there is no state in the Union offering a richer field for the student of natural history than Colorado, whether it be in the line of minerology, paleontology, zoology or botany. Its broad stretch of arid plains crossed by streams of living water, its high mountain ranges, broad plateaus, innumerable gulches and deep canons, all combine to give it a most exceptional topography with a consequent diversified fauna and flora."

A very useful paper on the Cicadidae of Kansas, by P. B. Lawson, Kansas University Science Bulletin, Vol. XII, No. 2, March 15, 1920, was distributed in November, 1920. It contains descriptions of twenty-one species occurring in that state, also numerous figures of structural details. As eleven species of Cicadas have been found both in Kansas and Colorado, the paper will be helpful in considering those mentioned in the present list. There is, however, a considerable difference in the Cicada fauna of these two adjoining states, and it is always of interest to note the changes that take place in animal life as the one hundredth meridian is approached.

1. ***Tibicen linnei*** (Smith and Grossbeck).

Figured in JOURNAL, N. Y. Entomological Society, Sept.-December, 1918, Pl. 7, fig. 1.

"Colorado (E. V. Beales)," male without exact locality or date label. Through the courtesy of Prof. Myron H. Swenk, I have also been able to examine a female of this species in the collection of the University of Nebraska, labeled "Colorado." It is to be regretted that the information is not more complete.

There is a male in the writer's collection from West Point, Nebraska, and Mr. R. A. Leussler has sent me nine *linnei* from Omaha, collected in October, 1917, and August, 1919. From Wakefield, Clay Co., Kansas, I have two males and a female collected by Mr. J. C. Warren. From the Kansas and Nebraska data it would appear that the Colorado records are no doubt correct.

2. *Tibicen canicularis* (Harris).

Figured in JOURNAL, N. Y. Entomological Society, March, 1916, Pl. 3, fig. 2, and Sept.-Dec., 1918, Pl. 7, fig. 2.

This species is recorded from Colorado in Mr. Van Duzee's Catalogue of the Hemiptera of America North of Mexico, 1917.

In his List of Hemiptera of the Region West of the Mississippi River, including those collected during the Hayden explorations of 1873, Bulletin of U. S. Geological and Geographical Survey of the Territories, vol. 1, p. 342, 1876, Uhler says: "From the mountains of Colorado. The specimen corresponds in size, structure, and markings with those from eastern Massachusetts and other parts of New England. New Jersey seems to be the region where it varies most in size and kind of markings."

In the writer's collection there are six specimens from Aweme, Manitoba (Criddle), and a male from Sioux County, western Nebraska, collected August 17, 1908 (C. H. Gable). In the collection of the University of Nebraska there are five additional specimens from the same county.

This species must not be confused with *Tibicen aurifera* (Say), which it resembles.

3. *Tibicen marginalis* (Walker).

Figured in JOURNAL, N. Y. Ento. Society, March, 1915, Pl. 2, fig. 1, and December, 1915, Pl. 18, fig. 2.

"Colorado," male (E. V. Beales), University of Nebraska. This is the only specimen so far examined from Colorado, but we have

numerous Kansas and Nebraska records, so the locality is no doubt correct.

This species does not as a rule inhabit as dry situations as *dorsata* and *dealbata*.

4. **Tibicen dealbata** (Davis).

Figured in JOURNAL, N. Y. Entomological Soc., Sept. 1915, Pl. 12, fig. 2.

This species was described in the JOURNAL, N. Y. Ento. Society, vol. 23, p. 162, Sept., 1915, and at that time was recorded from the following localities in Colorado, the dates of capture being in July, August and September: Denver; Platte Canyon, Jefferson Co.; Chimney Gulch, Golden; Pueblo, Pueblo Co.; Colorado Springs, and Durango, La Plata Co.

The following are additional records: Snyder, Morgan Co., Aug. 8, 1899, female, Univ. of Kansas; Ft. Lupton, Weld Co., male, collection Dr. E. D. Ball; Platte Canyon, Jefferson Co., Aug., 9,000 ft., four males (Osler); Pueblo, July 31, 1907, female, and Aug., 1907, male (G. M. Hite), Univ. of Colorado; Pueblo, Aug. 9, 1920, male in vacant lot, captured by *Sphécus* wasp (Dr. Lutz), Am. Museum of Natural History; Nepesta, Pueblo Co., male, collection Dr. E. D. Ball; La Junta, Otero Co., July 22-23, 1919, male and two females (Rehn and Hebard). Mr. Morgan Hebard states that this species inhabits dry situations. La Junta, August 11-13, 1920, about 4,100 ft., male (Dr. Lutz), Am. Museum of Natural History.

Writing of this species from Foss, western Oklahoma, in August, 1916, Miss Anna Bennett says: "The cicadas have all disappeared except the white-sided ones. These are very numerous here this year. In fact they are almost a pest. They sing in the evening and early part of the night. In the morning they are usually rather stupid and sleepy and are in the short weeds and grass out from the trees for a few rods, but start up with a loud noise and are quite easily caught in a net or even in the hands. They always fly for the trees and often sing after they light for a short time." Miss Bennett sent me 302 specimens of *dealbata*, well justifying her statement that the "white-sided ones" were very numerous about Foss, Oklahoma, in 1916.

Dr. Raymond H. Beamer writes that he found this species associated with *dorsata* in Kansas.

5. *Tibicen dorsata* (Say).

Figured in JOURNAL, N. Y. Entomological Society, Sept., 1915, Pl. 12, fig. 1.

In the Bulletin of the U. S. Geological and Geographical Survey of the Territories, Vol. 1, p. 342, 1876, Uhler says: "This is the grandest and most beautiful of the large western species of *Cicada*. Its note is said to be loud, piercing, and sustained, and from the great strength of the base of the wings and their fasciculæ of muscles the species must be one of the most vigorous and rapid in flight. The specimens here noticed were collected in Colorado by Prof. C. Thomas."

Dr. Raymond H. Beamer, in an account of his collecting trip in Kansas in 1916, writes that *dorsata* was the most widely spread and abundant species taken. It was commonly found on low shrubs or weeds and grass, often on barren hill tops.

Colorado records are as follows: Laporte, Larimer County, female, September 12, 1906, Colorado Agricultural College; six miles west of Loveland, Larimer County, male, August 20 (W. Foster), University of Colorado; Ft. Collins, August 1, 1903, male, Colorado Agri. College; Collins, August 19, 1898, male, University of Nebraska; Ft. Sterling, Logan County, July 11, 1909, 4,000-4,100 ft., male, Acad. Nat. Sciences of Philadelphia; Ft. Lupton, July 25, 1900, two males, collection Dr. E. D. Ball; Ft. Lupton, July 25, 1900, male, Colorado Agri. College; Wray, Yuma County, July 13, 1899, male, University of Kansas; Wray, August 17, 1919, about 4,411 ft. on sunflowers, sagebush, etc., two males (Dr. Lutz), Am. Museum of Natural History; Rocky Ford, Otero County, August 7, 1900, female, collection Dr. E. D. Ball; La Junta, Otero County, August 11-13, 1920, about 4,100 ft. on arid hills, male (Dr. Lutz), Am. Museum of Natural History.

6. *Tibicen duryi* Davis.

Figured in JOURNAL, N. Y. Ento. Soc., Dec., 1917, Pl. 13, fig. 2.

Bondad, June 27, 1919, 6,100 ft., male (Dr. Lutz), Am. Museum of Natural History.

This species is very common at times in New Mexico, and will no doubt be found abundant in parts of Colorado as well. It is a beautiful insect, and is colored near the base of both pairs of wings bright

orange or orange and gray, and in this and other respects looks at first glance, especially when the wings are closed, much like some of the species of *Okanagana* among which it lives.

7. ***Tibicen bifidus*** (Davis).

Figured in JOURNAL, N. Y. Entomological Society, March, 1916, Pl. 4, figs. 3-4.

Fort Collins, June 28, 1900, three males, two females, collection Dr. E. D. Ball; Fort Collins, June 28, 1900, male and June 29, 1901, male and two females, Colorado Agri. College; Salida, Chaffee Co., 1885, male, University of Nebraska; Pueblo, June 15, 1900, female, collection Dr. E. D. Ball. The male type came from Clear Creek, Colorado.

8. ***Cacama valvata*** (Uhler).

Figured in JOURNAL, N. Y. Entomological Society, March, 1919, Pl. 13, fig. 1.

In Cicadas of the Genus *Cacama*, with Descriptions of Several New Species, JOURNAL, N. Y. Entomological Society, March, 1919, Colorado specimens are recorded from Pueblo, Carson City, Trinidad, Cañon City, Holly, Coolidge and Fort Collins, with dates of capture in June and July. In the collection of the Colorado Agricultural College there are additional specimens from Fort Collins, June 28, 1900, male and female, and Pueblo, June 15, 1900, male and female.

This species, according to Mr. John Woodgate of Jemez Springs, New Mexico, is often found on bush-cactus.

9. ***Proarna venosa*** (Uhler). Plate V, fig. 1.

Cañon City, July 2, 1885, two males, one female, and July 3, male, collection University of Nebraska.

In July, 1917, Dr. H. H. Knight collected this small species very commonly "on desert grass" at Aden, New Mexico. At Foss, Oklahoma, July, 1916, Miss Anna Bennett reported finding a male on a thistle near the roots of a cottonwood "singing as loud as possible." Dr. Raymond H. Beamer has taken this species in Kansas in grass and weeds, where they were located by their song, which was low through shrill.

10. *Okanagana cruentifera* (Uhler).

Figured in JOURNAL, N. Y. Entomological Society, June-Sept., 1919, Pl. 19, fig. 2.

Bondad, June 27, 1919, 6,100 ft., three females (Dr. Lutz), American Museum of Natural History.

11. *Okanagana magnifica* Davis.

Figured in JOURNAL, N. Y. Entomological Society, June-Sept., 1919, Pl. 19, fig. 1.

In the original description a female is reported from Nucla, Colorado, Sept. 7, 1907 (C. T. Trueb), collection U. S. National Museum. The following localities can now be added: Bondad, June 27, 1919, 6,100 ft., three males, five females, found among "sagebush, oak, sabina, pinyon, cottonwood, etc." (Dr. Lutz), Am. Museum of Natural History; Mesa Verde, July 3-7, 1919, 7,300 ft., six males, three females, found among "pinyon, sabina, sagebush, etc." (Dr. Lutz), Am. Museum of Natural History. With these last mentioned specimens are two pupa skins, each about 30 millimeters in length, with broad stripes of a chocolate brown color on the hind margins of the abdominal segments. This is the largest species of *Okanagana* so far described.

12. *Okanagana schaefferi* Davis.

Figured in JOURNAL, N. Y. Entomological Society, March, 1915, Pl. 3, fig. 4.

The only two records for this species in the state, is the published one of a male from Salida, June, 1885, collection, University of Nebraska, and a male recently found in the collection of the U. S. National Museum, labeled simply "Colorado."

Mr. George P. Engelhardt has informed me that the song of this species closely resembles the whirring noise produced by a rattlesnake, and that on one occasion in June, 1917, in Washington County, Utah, he came very nearly being bitten by a snake while searching in a small bush for the supposed Cicada. Mr. J. Duncan Putnam in his "Remarks on the Habits of Several Western Cicadae," Proceedings, Davenport Academy of Natural Sciences, March, 1881, records his experience with a species of Cicada belonging to the present genus *Okanagana*: "The male makes a rattling noise, exceedingly like that of a rattlesnake. This resemblance was so close

that one day in 1873, in the Shoshone Mountains, I was attracted by a noise which I took to be one of the insects, and stooped to pick it up, when I suddenly discovered a huge rattlesnake in its stead."

13. *Okanagana bella* Davis.

Figured in JOURNAL, N. Y. Entomological Society, June-Sept., 1919, Pl. 20, fig. 1.

In the original description this species was recorded from Livermore, Ft. Collins, Estes Park, Golden, Russell, Creede and Durango in Colorado, with dates of capture from June 24 to August 1. To these records may be added the following: Lily, Moffat Co., June 30, male and two females (J. W. Frey), Am. Museum of Natural History received from University of Colorado; Fort Collins, June 29, 1901, two males and two females, Colorado Agri. College; Colorado Springs, El Paso Co., male and female (H. B. Baker), University of Michigan; The South Fork, Rio Grande, June 17, 1919, 8,500 ft., two females, "cold at night, about 42°" (Dr. Lutz), Am. Museum of Natural History; Wolf-Fall Creek, Mineral Co., June 20, 1919, 7,900 ft., male (Dr. Lutz), Am. Museum of Natural History; Pagosa Springs, June 21-23, 1919, 7,500 ft., two males (Dr. Lutz), Am. Museum of Natural History. In the Academy of Natural Sciences, Philadelphia, there are fourteen males from Sedalia, Colorado, and in the writer's collection two males and a female from Breckenridge, 9,000 ft., July (Oslar). In these sixteen specimens, as in most other males from Colorado, the valve is pale in color.

The song of this species is described by Dr. Lutz, as having the clicks run close together, and continued for a long while.

14. *Okanagana synodica* (Say). Plate V, fig. 2.

Thomas Say says in the original description: "Dr. James and Mr. Peale observed this species in great numbers in one locality, at the base of the Rocky Mountains, but it did not occur elsewhere."

Uhler says in the Bulletin of the U. S. Geological and Geographical Survey of the Territories, Vol. 1, p. 341, 1876: "This pretty little species seems to be common in Eastern Colorado. The present specimens were collected in that region by Mr. B. H. Smith and by Prof. C. Thomas."

Mr. Joseph Duncan Putnam in his "Remarks on the Habits of

Several Western Cicadæ," already referred to, records that "*Cicada synodica* Say, was quite common on the grassy plains near Denver and Boulder, in Colorado, in June, 1872. The male makes a tolerably loud rattling noise."

Gillette and Baker in their Preliminary List of the Hemiptera of Colorado, record the species from near Cañon City, August 11 (Uhler); Southern Colorado, June to July (Carpenter); Fort Collins, June 21 (Baker) and July 5 (Gillette); Manitou Park (Snow).

In the JOURNAL, N. Y. Entomological Society, June-Sept., 1919, the species is recorded from Denver, Ft. Collins, Pueblo, Lamar and Salida, with the dates of capture in May, June and July.

To the above records may be added: Walsenburg, June 14, 1919, 6,200 ft., seven males, one female, "chiefly on grass and low weeds" (Dr. Lutz), Am. Museum of Natural History; Boulder, female (Prof. Cockerell); Clear Creek Canyon, June 24, 1920, 7,500 ft., five males (Osler).

15. *Okanagana utahensis* Davis.

Figured in JOURNAL, N. Y. Entomological Society, June-Sept., 1919, Pl. 20, fig. 4.

Mesa Verde, Montezuma Co., July 3-7, 1919, 6,600 ft, male, and Bondad, June 27, 1919, 6,100 ft., male. Both specimens in the Am. Museum of Natural History and collected by Dr. Lutz, who states that the song is continuous. This species has not before been reported from Colorado.

16. *Okanagana hesperia* (Uhler). Plate V, fig. 4.

Denver City, Colorado, is the type locality given by Uhler in the original description.

In the JOURNAL, N. Y. Entomological Society, June-Sept., 1919, this species is recorded from Denver, Golden, Fort Collins, Platte Canyon, La Junta, and Trinidad. The dates of capture are from June 10 to July 17.

To the above records may be added: Colorado Springs, male (H. B. Baker) collection University of Michigan; La Junta, July 22-23, 1919, female (Rehn and Hebard); Animas, June 26, 1919, 6,600 ft., two males, and Bondad, June 27, 1919, 6,100 ft., "song continuous" (Dr. Lutz), Am. Museum of Natural History.

17. *Platypedia mohavensis* Davis.

Figured in JOURNAL, N. Y. Entomological Society, June, 1920, Pl. 5, fig. 1.

The only Colorado record for this species is the one already published in the original description, namely Bondad, June 27, 1919, male and three females (Dr. Lutz), Am. Museum of Natural History.

18. *Platypedia putnami* (Uhler).

Figured in JOURNAL, N. Y. Entomological Society, June, 1920, Pl. 5, fig. 3.

In the original description in 1877, Uhler states that the types were "collected in the vicinity of Clear Creek, Colorado, by Mr. J. Duncan Putnam." In the Proceedings of the Davenport Academy of Natural Sciences, Vol. 3, March, 1881, there are some "Remarks on the Habits of Several Western Cicadae," by Mr. Putnam, made at the meeting of January 31, 1879, as follows: "*Cicada putnami* Uhler (Vol. 2, Plate 4, figs. 3 and 4) I have collected only upon one occasion, July 2, 1872. It occurred in considerable numbers on some small aspen trees growing close to the water of Clear Creek, between Floyd's Hill and Idaho Springs, Colorado. The male makes a very faint chirp, differing entirely from any other Cicada I have ever heard. This species does not appear to have been collected since."

Specimens from the following localities are recorded in the JOURNAL, N. Y. Entomological Society, for June, 1920: Fort Collins, Boulder, Bear Creek in Jefferson Co., Chimney Gulch, Golden, Platte Canyon, Manitou, Canon City, Alamosa, Mesa Verde in Montezuma Co., Durango, Bondad, Pagosa Springs, and Starkville. The dates of capture are from May 13, 1901, at Chimney Gulch (Dyar and Caudell), to July 3-7, 1919, at Mesa Verde at an elevation of about 7,300 ft.

All observers report the notes of the several species of *Platypedia* as a series of short *clicks*, and Dr. Lutz states that those he collected at Starkville produced a "clicking sound; about eight clicks, rapid at first, but slowing."

Additional records are as follows: Fort Collins, June 16, 1899, three females and June 22, 1899, female, collection Colorado Agri. College. Colorado Springs male and female (H. B. Baker), collection University of Michigan.

19. *Platypedia minor* Uhler.

Figured in the JOURNAL, N. Y. Entomological Society, June, 1920, Pl. 5, fig. 10.

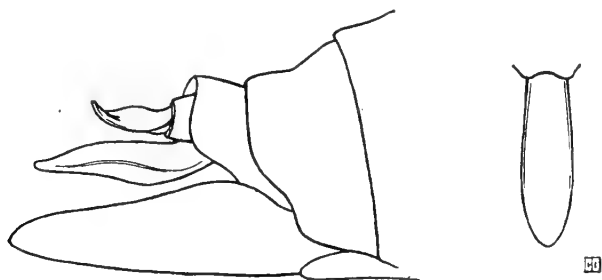
The only specimens I have seen from Colorado have already been recorded, and consist of the fifty-seven individuals collected at Glenwood Springs, June, 1919, by Mr. Oslar. The type locality for this species is San Mateo, California, but the Colorado specimens appear to be the same, though their distribution is unusual.

20. *Platypedia latipennis* new species. Plate V, fig. 5.

Type male, Douglas Spring, Routt Co., Colorado, June 26 (J. W. Frey). Collection American Museum of Natural History, received from University of Colorado.

The uncus resembles in shape that of *Platypedia mohavensis*, but the fore wings are broader and the front of the head not as prominent as in that species. The fore wings in form resemble those of *barbata* and *minor*, and have also a rather broad basal cell, but it is not nearly as hairy as either of those species, and the uncus is differently shaped.

Front of the head not prominent, median sulcus well defined and broadening on the lower part of the face. The whitish hairs on the body are about



PLATYPEDIA LATIPENNIS

as in *putnami*; the upper surface is nearly smooth except on the head and about the mesonotal \times , while beneath the hairs are long and numerous. The fore wings have eight apical cells, are very broad, and have the costal nerve rather suddenly bent near the end of the radial cell. When viewed from in front the costal nerve is seen to be wavy, suggesting an approach to *Neoplatypedia*. The uncus is slightly arched at the top, with the extremity rather flat and rounded; beneath it is somewhat deepened near the basal third; not as much so as in *putnami*, but more so than in *mohavensis*.

General color blue black with the lighter marks brilliant orange-red as in *putnami*, which indeed it strongly resembles in coloring, and for which it might be taken if it were not for structural characters. Fore femora entirely black

except the extremities, which are brilliant orange-red; middle and hind femora black above, orange-red beneath. The hind margin of the pronotum or collar is conspicuously orange-red, as are the membranes at the base of both pairs of wings.

MEASUREMENTS IN MILLIMETERS.

	Male Type.
Length of body	10.5
Width of head across eyes	5
Expanse of fore wings	42
Length of valve	4

Only the type has been examined, but the broad fore wings, and the shape of the uncus readily separate it from the other described species of *Platypedia*. This insect should be considered just after *barbata* in the Key to the Genera and Species of *Platypedia* and *Neoplatypedia* published in the JOURNAL, N. Y. Entomological Society for June, 1920.

21. *Neoplatypedia constricta* Davis.

Figured in JOURNAL, N. Y. Entomological Society, June, 1920, Plate 5, fig. 13.

The only Colorado specimens so far examined are the fifteen males and twenty-two females collected by Dr. Lutz at Bondad, June 27, 1919, and now in the collection of the Am. Museum of Natural History. It was noted when the insects were collected that the song was a *zip, zip, zip* continued for a long time.

22. *Melampsalta calliope* (Walker), 1850.

Cicada parvula Say, 1825; name preoccupied.

Cicada pallescens Germar, 1830; name preoccupied.

Figured in JOURNAL, N. Y. Entomological Society, June, 1920, Pl. 5, figs. 14 and 15.

The only Colorado specimens so far examined are a male and a female in the U. S. National Museum, collected at Granada, Prowers Co., in the eastern part of the state. It is a common species in parts of Kansas and Nebraska.

23. *Melampsalta kansa* Davis.

Figured in the JOURNAL, N. Y. Entomological Society, June 1920, Pl. 5, fig. 17.

In the paper on the North Am. Cicadas belonging to the Genera

Platypedia and Melampsalta, published in this JOURNAL for June, 1920, five males collected by the American Museum Expedition, in June, 1919, are recorded from Regnier and Lamar. To these may now be added one male and three females from Lamar, June 17, 1900, recently sent to me for examination from the Colorado Agricultural College. The entirely green Cicada from near the Rocky mountains, which Thomas Say wrote about in 1825 in connection with his *Cicada parvula*, is supposed to have belonged to this species.

FOSSIL SPECIES.

Cicada grandiosa Scudder.

This species was described and wing figured in the Bulletin of the U. S. Geological Survey, No. 93, 1892, in an article entitled "Some Insects of Special Interest from Florissant and other Points in the Territories of Colorado and Utah."

In the Bulletin, American Museum of Natural History, Vol. 30, 1911, p. 76, Prof. T. D. A. Cockerell comments upon this insect as follows: "This species was based by Scudder on a hind wing, which was remarkable for its large size, and supposed to differ from true *Cicada* in several venational characters. The wing, however, agrees very nearly with that of the living American *Cicada marginata* [*marginalis* Walker], and I believe represents a quite typical *Cicada*. In March, 1911, my wife and I found at the south end of Fossil Stump Hill, Florissant, a rather poorly preserved upper wing of *Cicada*, showing all the central area, including the forking of the radius and cubitus, the median cell and the two large discal cells above it. All of this is perfectly typical for *Cicada*, and might almost have come from a wing of *C. marginata*. The large cell in the forks of the media has its side on the cell (median) below 12 mm. and that on the cell above 10 mm. As the proportions agree exactly with the upper wing which should go with Scudder's hind wing, it seems safe to assume that they belong to the same species."

Lithocicada perita Cockerell.

Described and figured in the Bulletin Am. Museum of Natural History, vol. 22, 1906, p. 457, from a plainly represented anterior wing 23 mm. in length and 10½ broad, showing almost complete venation. The costal margin is very much bent near the apex of



(CICADIDAE).



the wing; the radial cell does not extend beyond the middle, and the eighth apical cell is very large and inversely triangular.

Platypedia primigenia Cockerell.

Described and figured in The American Journal of Science for January, 1908, p. 52, from a well preserved specimen found at Florissant in 1907. The following are some of the salient characters: Length about 23 mm. (the apex of abdomen is lost). Compared with the living *putnami*, the body is larger and more robust. As in that species the femora are black. *P. primigenia* will be easily known from *Lithocicada perita* Cockerell, by the shape of the eighth apical cell, and from *Cicada grandiosa* Scudd., by the much smaller size.

It is interesting to learn that the genus *Platypedia* was represented in Colorado in Miocene times, as it is today.

EXPLANATION OF PLATE V.

- Fig. 1. *Proarna venosa* (Uhler).
- Fig. 2. *Okanagana synodica* (Say).
- Fig. 3. *Okanagana striatipes* (Haldeman).
- Fig. 4. *Okanagana hesperia* (Uhler).
- Fig. 5. *Platypedia latipennis* Davis. Type.

MISCELLANEOUS NOTES

Aglais j-album Boisduval and LeConte.—A female of this species flew in my office window, at Broadway and Houston Street, New York City, September 8th, 1920. I have not noticed any other Manhattan Island records. The specimen is in the collection of The American Museum of Natural History.—GAYLORD C. HALL.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF MAY 20.

A regular meeting of the New York Entomological Society was held at 8:00 P.M., on May 20th, 1920, in the American Museum of Natural History, President L. B. Woodruff in the chair, with 19 members and five visitors present.

Mr. Watson read a paper on "Collecting Insects in Jamaica, B. W. I.," illustrated by maps, photographs and two cases of lepidoptera. Mr. Watson left New York, November 6, 1919. *Erebos odora* was the first capture, Nov. 11th, and for three months thereafter he collected assiduously, his headquarters being at Mandeville. There he met E. Stuart Panton and visited his bungalow at 3,000 ft. elevation, where the collecting at light was good. At Kingston he met Frank Cundall, Secretary of Jamaica Institute, and had an opportunity of seeing their entomological collections. Special attention was paid to collecting Sphingidæ, at flowers about dusk; their swift flight making quick work necessary. Mr. Watson gave many notes on his captures which may be published later, and spoke gratefully of the generosity of Mr. B. Preston Clark and of the courtesies of Dr. Harry Farquharson of Jamaica.

His remarks were discussed by Mr. Mutchler, who exhibited the Lampyridæ he had collected, and by Messrs. Davis, Engelhardt and Olsen.

Mr. Davis called attention to May 20, 1920, being the 82d anniversary of Mrs. Annie Trumbull Slosson and the congratulations of the Society were ordered to be sent to her by letter.

Dr. Bequaert spoke on "Fungi that grow on Ants," giving a general review of the classification of such fungi, illustrated by blackboard sketches and specimens. His remarks have been published in Bull. Br. Ent. Soc. XV, pp. 71-79, and were discussed by Messrs. Engelhardt and Davis, the latter recalling numerous examples of the genus *Cordyceps* on beetle larvæ and pupæ.

Mr. Nicolay spoke of his trip to Manumuskine and Maurice River and Malaga, N. J., resulting in the capture of four *Buprestis salisburyensis*.

Mr. Dickerson exhibited Bull. Cal. Agl. Dept., IX, No. 4, on the control of Mealy Bugs, especially by the introduction of natural enemies, Hymenoptera from Sicily and lady bugs from Australia.

His remarks were discussed by Dr. Marchand and Mr. Davis.

MEETING OF OCTOBER 5.

A regular meeting of the New York Entomological Society was held at 8:00 P.M., October 5, 1920, in the American Museum of Natural History, President L. B. Woodruff in the chair, with 20 members and four visitors present.

The Secretary distributed copies of a pamphlet on the Japanese Beetle, presented by Mr. John J. Davis.

The Librarian reported accessions to the Library.

The President called for reports on summer collecting. Mr. Hall spoke of collecting Lepidoptera on Mt. Washington, commenting on the variation in seasons there in different years.

Mr. Bell reported poor collecting locally in Lepidoptera.

Mr. Burns reported good success in Diptera.

Mr. Nicolay showed two boxes of notable captures at Washington, D. C., in June and of rare Buprestidae received from British Museum and the Pacific Coast, especially two species of *Trachykele*, bred from *Abies* and *Libocedrus*.

Among his Washington captures was *Chevrolatia amoena*, found by sifting debris at base of half-dead tulip tree. Mr. Weiss said he had been working principally on Milkweed Insects this summer with some interesting results. He spoke also of the Gypsy Moth outbreak at Somerville, N. J.

Mr. Barber's principal trip had been at Lakehurst, N. J., where rain had marred his plans.

Dr. Lutz reported three months spent in Wyoming, Idaho, Utah and Colorado with interesting comparisons of collecting in the northern and southern regions. He also showed magnification of three-color process from the publication "Science and Invention."

Mr. Dickerson said his best result was the discovery of *Tetraopes* larvae.

Mr. Bischoff exhibited a box of rare Coleoptera collected during the summer, including species of *Rhynchophora*, *Eucnemidae*, etc.

Mr. Davis as usual had much field activity to report, including three weeks in North Carolina with Jas. P. Chapin, and many Long Island trips with Mr. Engelhardt. He exhibited pink *Amblycorypha* from Staten Island, commenting on their apparent comparative frequency there, *Calosoma sycophanta* and *Carabus nemoralis*, also from Staten Island, and described their distribution and usefulness.

Mr. Mutchler spoke of *sycophanta* being common also in Connecticut.

Dr. Bequaert spoke at some length of the rarer flies caught by Mr. Burns, especially *Mixogaster breviventris* and then spoke of his visit to Mr. Notman at Keene Valley, of his trips to West Nyack, Cold Spring Harbor and elsewhere, closing with an account of his recent discoveries in the genus *Pohucella*.

In reference to Dr. Bequaert's praise of Cold Spring Harbor as a collecting ground, Mr. Bischoff urged consideration of Murray Hill, N. J.

Dr. Wiegmann spoke of a collection of microscopic mounts of insects.

Mr. Sherman spoke of his trip to Atlantic City and visits in Philadelphia with Fox, Laurent and Castle.

Mr. Olsen told of his collecting about West Nyack.

Mr. Hallinan spoke of his visits to public museums in London, Hull and Bristol.

Mr. Shoemaker had visited his old collecting grounds near Washington, D. C., in June and September and found the increasing number of bungalows distressing. Three species of *Cychrus* had, however, been caught this year.

Mr. Leng described the extraordinary abundance of coleoptera on the shingly beach of North Hero Island, Lake Champlain.

Mr. Woodruff spoke of his visit to Mrs. Slosson at Delaware Water Gap and of his collecting at Litchfield, Conn.

Mr. Eugene G. Smyth, present as a guest, spoke of the supposed transmission of Sugar Cane Mottling Disease in Porto Rico by insects.

Mr. Davis exhibited a bound volume of Mr. Sherman's catalogues of books on insects; also Blatchley's Orthoptera of the Eastern United States and Morse's New England Orthoptera.

MEETING OF OCTOBER 19.

A regular meeting of the New York Entomological Society was held at 8:00 P.M., on October 19, 1920, in the American Museum of Natural History, President L. B. Woodruff in the chair, with 21 members and four visitors present.

Mr. Barber read a paper on "A New Species of Thaumastocorid from Cuba" (which has since been published in Bull. Br. Ent. Soc.), illustrated by specimens and blackboard illustrations. It was discussed by Messrs. Woodruff, Hallinan, Bequaert and Lutz; the latter pointed out that it might prove another interesting instance of discontinuous distribution of a primitive subfamily, Mr. Barber having established that the nearest relatives are known from New South Wales and Tasmania. The specimens were found by Dr. Mario Calvino crawling in crevices in young growth of the Royal Palm.

Dr. Bequaert spoke on "Dispersal of Spores of Certain Mosses by Flies," showing specimens of the flies and of the mosses, and blackboard drawings of the latter. The mosses as identified by Dr. Wiegmann, were *Tetraplodon mnioides* and another species of the genus which grow only on dung or carrion and in northern or elevated or otherwise boreal situations. The fructification, instead of being dry so as to be readily dispersed by wind, is sticky; and apparently depends upon the fly in this case, a species of *Phorbia*, to carry it from the capsule to fresh dung or carrion. The bright color of the hypophysis attracts the fly and from its large stomata exudes a substance of which the odor also probably acts as an attraction. Dr. Bequaert's investigations were made while Mr. Notman's guest in the Adirondacks and at an elevation of about 5,000 ft. on July 28.

Mr. Dickerson exhibited the Monthly Bulletin of California State Exp. Station containing an article on Black Scale Parasite, particularly in reference to Parthenogenesis.

Mr. Wm. T. Davis read a clipping from a newspaper stating that October 14, with a temperature of 82 degrees, was the hottest October day recorded in New York City. October 15 was also very warm. On these days the large imported wasps, *Vespa crabro*, were encouraged to renew their activities in nest building and a number were seen gnawing off the living bark of a lilac bush in the Clove Valley on Staten Island.

He stated that these wasps did not fit very well into their environment, and would be forced to discontinue building operations on their unfinished nest, at which time the workers would perish.

He showed several specimens with particularly yellowish abdomens that had been captured in molasses traps set for Orthoptera near Great Kills, Staten Island.

Mr. Leng exhibited "Larvæ of North American Beetles of the Family Cleridæ," by Adam G. Boving and A. B. Champlain, from Proc. U. S. N. M., LVII, pp. 575-649 with ten plates.

Mr. Mutchler exhibited "Catalogus alphabeticus generum et subgenerum Coleopterorum orbis terrarum totius," by R. Lucas, from Archiv f. Naturg. LXXXIV, Abt. pp. 1-696; and pointed out that it was yet incomplete, in that some of the largest families were omitted.

THE NEW YORK ENTOMOLOGICAL SOCIETY.

Organized June 29, 1892.—Incorporated June 7, 1893.

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

Annual dues for Active Members, \$3.00.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

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WILLIAM T. DAVIS.

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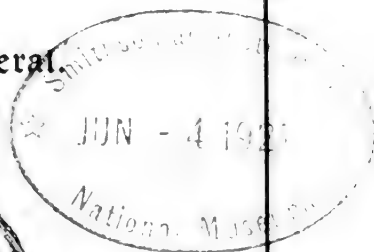
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Devoted to Entomology in General.



JUNE, 1921.

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CHARLES SCHAEFFER

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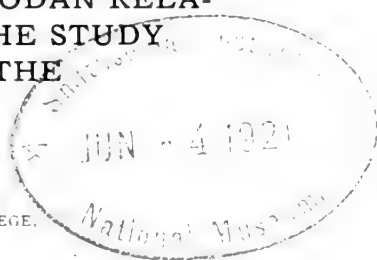
JUNE, 1921.

No. 2.

THE PHYLOGENETIC ORIGIN OF THE MANDIBLES OF INSECTS AND THEIR ARTHROPODAN RELATIVES—A CONTRIBUTION TO THE STUDY OF THE EVOLUTION OF THE ARTHROPODA.

By G. C. CRAMPTON, PH.D.,

MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, MASS.



The study of the mandibles alone has furnished but a small portion of the evidence upon which the conclusions concerning the evolution of insects and their arthropodan relatives, set forth in the following series of papers, are based. It is obviously impracticable, however, to attempt to present all of the evidence available on the subject, in a single paper, since it would require too great a number of plates to illustrate the various features of comparative anatomy, embryology, etc., which must be considered in such a discussion. On this account, it has seemed preferable to present the evidence gained from a study of the remaining features of the comparative morphology of the mandibles (the origin of only one type in insects has been discussed in the present paper), as well as that gained from the study of the head capsule with its appendages, the trunk segments and their appendages, the terminal abdominal structures, the embryological development of the arthropods in question, and all other features having a bearing on the study of the phylogeny of the Arthropoda, in a series of papers dealing with each phase of the

subject separately; and the following discussion is therefore offered as the first of such a series of papers dealing with the more important features of value in the study of arthropodan evolution.

It is extremely difficult for anyone who is not a specialist in the Crustacea to obtain specimens of the rarer forms for dissection, and on this account, it has been necessary for me to depend upon the descriptions of others for the morphological details of certain of the rarer Crustacea such as the Euphausiacea, *Anaspides*, etc., but I have been fortunate in being able to examine representatives of these forms, and I have been able to dissect other types sufficiently close to these to enable me to form an opinion as to their relationships—and luckily, those types of Crustacea which are of the greatest importance for a study of the phylogeny of insects, are obtainable from the biological laboratories of Europe.

I would use this opportunity of expressing my very sincere gratitude to Miss Rathbun for the loan of a specimen of *Anaspides* and other interesting material from the U. S. National Museum, and to Dr. Calman of the British Museum for specimens of the interesting crustacean *Apscudes*. Dr. Chamberlin of the Harvard Museum has furnished me with interesting and valuable myriopodan material, and Dr. Walcott of the Smithsonian Institution has very generously given me a number of photographs of trilobitan appendages, and has very kindly allowed me to copy Fig. 18 (Plate VII) from his restoration of the appendages of the trilobite *Necolenus*. I am also deeply indebted to Dr. Raymond of the Harvard Museum for much valuable information concerning the affinities of trilobites; and Fig. 9 (Plate VI) is based upon a restoration of the trilobite *Triarthrus* made by him.

GENERAL CONSIDERATIONS.

It is indeed astonishing that so little attention has been given to the evolution of the members of the phylum Arthropoda, since no other group of living things can equal or even approach them in the number of their species, in the multiplicity of their modifications of structure and habit, or in their preservation of synthetic types serving to connect the various subdivisions of the group. The survival of ancient types but little modified from their primitive condition, such for example as *Apus*, which has changed but little since Cam-

brian times, enables us readily to compare the more recently evolved forms with their "contemporaneous ancestors," and it is therefore frequently quite easy to obtain an almost unbroken series of stages illustrating the probable steps in the evolution of certain structures almost from the very inception of the development of the tendency on the part of these structures to assume their more modified aspects. Since I have been fortunate in obtaining an exceptionally fine series illustrating the probable course of the phylogenetic development of one type of insectan mandible, it has seemed preferable to make this the subject of the first paper dealing with the evolution of arthropods related to insects.

Since no living types are strictly speaking "ancestral" to other living types (excepting in the case of mutants which have departed but little from the parent stock), it should be clearly understood that in employing a number of recent forms to illustrate the path of evolution followed in deriving the insectan type of mandible from the original arthropodan type of mandibular appendage, I would not imply that any one of the stages represented in the series is actually ancestral to the succeeding stages. On the other hand, certain primitive living forms have departed but little from the actual ancestors of other living forms in many respects, and those "ancestral" features which they have preserved in a very slightly modified form, serve to indicate the probable stages through which the parts of other more highly modified forms have passed, in assuming their present condition; and the study of such a series is of the greatest value in enabling us to gain a correct understanding of the nature of the parts in the higher forms.

As a rule, the student of trilobitan structures has confined his attention to this group alone, and the carcinologist is content to devote his energies to the study of the Crustacea alone, while those entomologists who have attempted to invade these fields have not been conspicuously successful in comparing the structures of insects with those of Crustacea and trilobites, with the result that the true nature of the parts of insects is not understood in many cases, and the most glaring misinterpretations of insectan structures have gained a dishearteningly widespread acceptance in the various textbooks and publications dealing with this phase of entomology. In this con-

nection I need but cite the universally accepted, though erroneous, conclusion that the "superlinguæ" of insects (which are the homologues of the paragnaths of Crustacea) represent the first maxillæ (maxillulæ) of Crustacea, and the resultant false conclusions that the first maxillæ of insects (which are homologous with the first maxillæ or maxillulæ of Crustacea) represent the second maxillæ of Crustacea, while the second maxillæ (labial appendages) of insects are incorrectly homologized with the first maxillipeds of Crustacea, instead of correctly homologizing them with the second maxillæ of Crustacea. As a consequence of these false views, the head of an insect is regarded by some entomologists as composed of seven segments (instead of but six, as embryology has long shown to be the case), and the true homologies of the structures of the head of an insect have been greatly confused.

Not only has the composition of the head in general been misinterpreted by many entomologists, but the nature of the parts of the mouth structures has not been properly understood, due to the fact that no one has apparently made a thoroughgoing comparison of these structures in insects, Crustacea and trilobites. Thus Chatin, Smith, and other entomologists who are apparently not aware of the fact that the mandible of an insect represents only *one* segment of a modified limb, while the "body" of the maxilla (not including the *cardo* and *palpus*) is composed of at least *two* segments of such a limb, have made the unfounded claim that the parts of the maxilla are repeated in the mandible; and such investigators as Hollis, 1872, or Heymons, 1896, who have mistaken the *lacinia mobilis* and processes of the incisor region of the mandibles of insects for so called mandibular "palpi," homologous with the mandibular palpi of Crustacea, are apparently not familiar either with the nature of the mandibular palpi of Crustacea, or with the structure of mandibles in various insects, since the structures occurring on the mandibles of insects which they attempt to homologize with the mandibular palpi of Crustacea, do not occur in the same position occupied by the palpi of the latter forms, and they have nothing of the nature of palpi to warrant interpreting them as such.

The fact that entomologists homologize the palpi of the maxillæ (or labium) with the exopodite of a crustacean limb, and homologize the galea and *lacinia* of the maxillæ with the endopodite of such a

biramous limb, clearly shows that they have not traced the modifications of the mouthpart limbs in a series of Crustacea leading up to the insectan type, in order to give an intelligent opinion in the matter; and the attempt of Wood-Mason, 1879, to homologize the incisor process of the mandible of *Machilis* with the exopodite of a crustacean limb, and to homologize the molar process of *Machilis*' mandible with the endopodite of a crustacean limb, well illustrates to what flights of fancy one may be led if he does not take the precaution of studying the modifications met with in the Crustacea and lower insects, before indulging in speculations concerning the interpretation of the structures of insects in terms of crustacean anatomy! Furthermore, the fact that an entomologist of the reputation of Folsom, 1900, should suggest that the mandibular palpi of Crustacea represent the exopodites of crustacean limbs, very clearly indicates (in addition to the other instances cited above) that entomologists in general are not sufficiently familiar with the developmental tendencies exhibited by Crustacea and other forms related to lower insects, to enable them to correctly analyze the conditions met with in lower insects. On this account, I have devoted the greater part of the present discussion to an attempt to trace the evolution of the mandibular appendage in those arthropods which approach the insectan type, instead of taking up the consideration of the evolution of the mandibles within the class Insecta—which I am hoping to discuss in a future publication on this subject.

ORIGIN OF ARTHROPODAN APPENDAGES.

The lines of descent of the Arthropoda are approached by those of the Onychophora, Tardigrada, Myzostomida and "Annelida"; but the lines of the descent of the Onychophora, Tardigrada and Myzostomida lead off toward paths of specialization which do not parallel that of the arthropods very closely, and the condition occurring in the appendages of these forms (see textfigures 9, 10, and 11) does not throw much light upon the subject of the nature of the precursors of arthropodan limbs, although a study of the condition found in the groups in question is not wholly without value. On the other hand, the annelids approach the arthropods in so many particulars, that I am more inclined to seek the type of structure foreshadowing an arthropodan

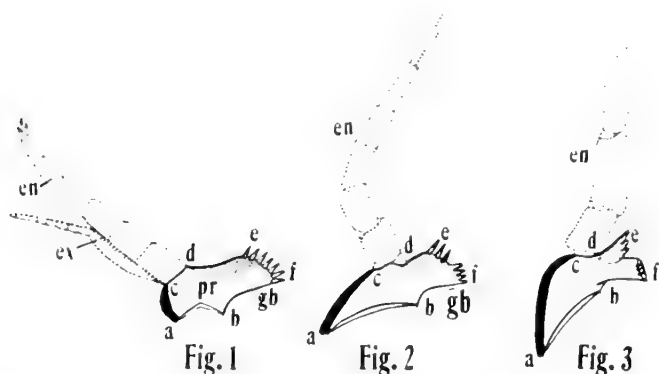
limb, in the so-called parapodia of the annelids (see textfigure 7) as is done by Borradaile, Boas, and many of the earlier zoölogists. It should be borne in mind, however, that in dealing with groups so far apart as the annelids and Crustacea, it is impossible to do more than guess as to what parts are homologous in the structures of the two groups, and the comparisons made below are more in the line of suggested possibilities, than definite statements of actual homologies.

In such annelids as *Laodice rubra* (textfigure 7) the anteriormost parapodium consists of a main axis "*en*" which bears a ventral cirrus "*ei*" and a segmented dorsal cirrus "*ex*." The second parapodium likewise bears a dorsal gill "*ep*" (dotted in the figure, since it is not present in the first parapodium) attached near the base of the parapodium. In comparing the parts of such a parapodium with those of a typical crustacean limb (textfigure 8—compare also Fig. 21, Plate VII) the position of the gills "*ep*" of textfigure 7 corresponds in a general way to that of the gills or epipodites "*ep*" of textfigure 8, while the dorsal cirrus "*ex*" of textfigure 7 occupies a position somewhat suggestive of that of the exopodite "*ex*" of the crustacean limb (textfigure 8). The main axis of the parapodium labeled "*en*" in textfigure 7 resembles the main axis of the crustacean limb ("*en*" of textfigure 8) in position, while the ventral cirrus labeled "*ei*" in textfigure 7, is somewhat suggestive of the endite or "gnathobase" labeled "*ei*" in textfigure 8. It is also quite possible that the main axis of the crustacean limb labeled "*en*" in textfigure 8, represents the main axis of the limbs "*en*" shown in textfigures 9, 10, and 11. These in turn may correspond to the main axis "*en*" of the parapodium shown in textfigure 7, although the main axis of the parapodium shows no signs of segmentation.

ORIGIN OF THE MANDIBLES.

Even such primitive worm-like forms as *Peripatus* have developed a mandible-like appendage in the mouth region (Fig. 31); but some investigators claim that the appendage in question in *Peripatus* is not strictly homologous with the mandibular appendage of Crustacea, insects and myriopods; and since the mouthparts of insects are merely modified limbs (as was pointed out over a century ago by Savigny, 1816, and has been confirmed innumerable times by embryological

investigations) we would expect that the most primitive type of mandible would be more like a walking-leg than a jaw-like appendage, and those arthropods in which the mandibular appendage is still in the "walking-leg stage" should therefore be taken as the starting



Textfigures 1 to 6 (compare with figures in plates) are diagrammatic representations of the stages in the development of the insectan type of mandible. For interpretation of lettering see list of abbreviations at end of paper. Textfigure 1. Mandibular limb of trilobite. Textfigure 2. Limb of merostome. Textfigure 3. Mandible of *Nebalia*.

point for tracing the evolution of the mandibular appendage in the higher forms.

Fortunately, in such primitive arthropods as the trilobites (*c.g.*, *Triarthrus becki*, which Beecher has studied with such signal success) we have an excellent starting point for the study of the evolution of the mouthparts of other arthropods, since in the trilobites the appendages which Beecher homologizes with the second antennæ, mandibles, first maxillæ, and second maxillæ of Crustacea, are all practically alike, and are almost exactly like the trilobite's "walking" legs. In fact, I know of no other arthropods which so well illustrate the fact that the mouthpart appendages are merely limbs of the "walking-leg" type adapted for holding and comminuting food. Since those mouthpart-limbs of a trilobite which are homologous with the second antennæ, mandibles, first maxillæ and second maxillæ of Crustacea, have not yet taken on the character of these appendages of the Crustacea, but are still "walking"-leg (or more accurately

"swimming" leg) like, I would refer to the appendages in question in the trilobite as protantennæ, protomandibles, protomaxillulæ and protomaxillæ, to indicate that they are the precursors of the second antennæ, mandibles, maxillulæ (first maxillæ) and maxillæ (second) of Crustacea, but have not yet become sufficiently modified to take on the form of these structures exhibited by the Crustacea, although the first antennæ (antennulæ) of trilobites have lost the walking-leg form and have taken on the character of true antennæ.

I have been astonished to find that in such ancient and apparently primitive Crustacea as *Apus* (Fig. 22) and *Branchippus* (Fig. 23) the mandibles have lost their original limb-like character and have assumed the form of true mandibular jaws. Even in the Copepoda (Fig. 30) and Ostracoda (Fig. 33) the mandibular appendages have become so far modified that the terminal portion of the mandibular limb has taken on the appearance of a palpus of the basal segment which forms the body of the mandible proper, despite the fact that the terminal portion of the mandibular limb (*i.e.*, the palpus) in these forms has still retained the inner branch "*en*" and outer branch "*ex*" of the primitive biramous crustacean and trilobitan limb (compare with textfigures 1 and 8, "*en*" and "*ex*"). On the other hand, the mandibular appendage (protomandible) of trilobites is almost exactly like a "walking" leg, and in the Merostomata, Pantopoda, Scorpionida, and the arachnoids in general, the appendage homologous with the mandibles of insects, myriopods, and Crustacea is more like a limb than it is like a jaw. I would therefore divide the arthropods into two subphyla, one of which the *Eugnathata* contains the Insecta, "Myriopoda," and Crustacea, and is characterized by the modification of the mandibular appendage to form a true mandible (with terminal segments either lost, or reduced to form a palpus); while the other subphylum, the *Podognathata*, contains the remainder of the arthropods, in which the mandibular appendage is essentially like a limb, the terminal segments being of such a character that they do not form a mere palpus-like organ for the basal jaw segment.

Such a division of the arthropods would group the trilobites with the Merostomata somewhat more closely than with the Crustacea, and such a grouping would be justified by the character of the head (which is flattened with the eyes located above), by the character of

the limbs (which have unjointed gnathobases in the two groups), and by the character of the segments and pygidium in trilobites and immature merostomes such as *Limulus*. On the other hand, the trilobites are very Crustacea-like in having biramous limbs, and other features strongly suggestive of crustacean affinities, and I would not minimize the fact that the trilobites are clearly annectant between the Crustacea and Merostomata; but, as I have pointed out in an article in the American Naturalist, and in the 51st Report of the Entomological Society of Ontario (Crampton, 1919A and 1919B) the main trend of the trilobitan developmental tendencies seems to lead more toward the development of the merostome type of arthropods, than toward the main line of the Crustacea and their descendants the myriopods and insects.

Raymond, 1920, who regards the trilobites as the ancestors of other arthropods, does not differ from me in this matter as fundamentally as his paper in the American Naturalist would imply, since I too regard the trilobites as very close to the ancestors of arthropods in general (as was stated in the article in the Report of the Entomological Society of Ontario for 1919); but I do not consider the trilobites as actual ancestors of the Crustacea such as *Apus*, etc. (and consequently of higher Crustacea also), since the Apodidae were contemporaneous with certain trilobites, and the earlier trilobites combine in themselves so many apodid and crustacean features, that I cannot avoid the conclusion that the first arthropods were more of the nature of trilobitan-Crustacea (or crustacean-Trilobita) rather than pure trilobites; and the inherent tendencies which flowed into the purely trilobitan side of the early arthropodan lines of development are mostly those which lead to the merostome type, rather than to the types of development exhibited by the Crustacea, and their descendants the myriopods and insects.

To return to the subject of the origin of the mandibles of Crustacea and their allies, it would appear that the precursors of the mandibles were leg-like appendages of the biramous type (see text-figure 1, and Fig. 9 of Plate VI) in which the basal segment became modified for holding or comminuting the food, while the endopodite ("en" of textfigure 1, and Fig. 9) or inner branch of the limb, still served to aid in the locomotion of the creature, and the exopodite

("ex" of textfigure 1, and Fig. 9) of the limb doubtless served as a gill—or it may even have aided in locomotion as well. The probable paths of development followed in the evolution of the different types of mandibles of interest from the standpoint of the development of the insectan type, have been sketched below.

EVOLUTION OF THE MANDIBLES.

As was mentioned above, the trilobitan type of biramous mandibular appendage, in which the exopodite "ex" (textfigure 1) is still retained, and the endopodite "en" still functions in locomotion, while the basal segment (like that of the body limbs as well) has become modified in a fashion which enables it to function in the holding and comminuting of food, serves as a convenient starting point in tracing the series of modifications leading to the production of the insectan type of mandible. The mesal region of the basal segment of the limb is produced to form the so-called gnathobase "gb" (textfigure 1, and Fig. 9 of Plate VI) which abuts against its fellow projecting from the limb of the opposite side of the body, and serves to manipulate and comminute the food (which was probably of the nature of soft bodied worms or similar creatures, as is the case with *Limulus* and related forms living today). The gnathobase is provided with stout spine-like projections which doubtless aided in comminuting the food, and I think that a portion of the surface bearing these projections becomes involved in the composition of the incisor region of the mandibles of higher arthropods. It is possible that the endite "gb" of the basal segment of the limb of *Apus*, shown in Fig. 20 (Plate VII) corresponds to the gnathobase "gb" of the trilobite shown in Fig. 18 (or in textfigure 1); but the other endites "ei" of the limb of *Apus* (Figs. 20 and 19) appear to be articulated appendages of the limb differing slightly from the gnathobase "gb" which is a prolongation of the entire mesal region of the basal segment of the limb in the trilobite shown in Fig. 18, for example.

A somewhat higher stage of development is represented by the condition exhibited by a limb of the merostome *Limulus* shown in textfigure 2 (compare with Fig. 8, Plate VI). As may be seen in textfigure 2, there is a tendency to lose the exopodite ("ex" of textfigure 1) in the limb of a merostome, while the point of attach-

ment of the endopodite is thrown forward by the lengthening of the area from "a" to "c" in the merostome, as may be seen by comparing the extent of the area from "a" to "c" (marked with a black margin to make the comparison easier) in textfigures 1 and 2. In Fig. 14 (Plate VII) of the gnathobase of a limb of *Limulus*, the proximal spine-like projections are closer together, and stouter than the distal ones, and on this account, I have represented the spine-like projections in the area labeled "f" in the merostome shown in textfigure 2, as though they were becoming more massed together than is the case with the spines in the stippled area "e" of the gnathobase.

The chief differences between the stages shown in textfigures 1 and 2 are thus seen to be the loss of the exopodite "ex," the shifting forward of the endopodite "en" through the lengthening of the area from "a" to "c" (margined in black), the shortening of the area from "d" to "e" (i.e., the stippled area), and the differentiation of the "masticating" area into an upper area "e" and a lower area "f" in which the spine-like projections become more "massed together." While the merostomes do not stand in the direct line of descent of the Crustacea, but are on a side line leading to the arachnoid type of arthropod, the merostomes have nevertheless retained the condition of the limbs in a fairly primitive state, approaching the condition which was doubtless characteristic of the limbs of a number of primitive forms a little more modified than the trilobites; and on this account the condition exhibited by the merostome appendage may be taken as representative of the stage of development intermediate between the trilobite shown in textfigure 1 and the crustacean shown in textfigure 3, despite the fact that the character of the body as a whole, in the merostomes, exhibits more arachnoid than crustacean features.

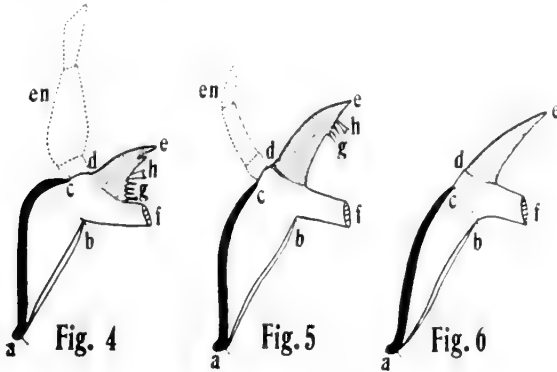
In the crustacean *Nebalia*, whose mandible is shown in textfigure 3, the mandibular appendage has taken on the character of a true mandible, through the reduction of the endopodite "en" to a three-segmented palpus, the differentiation of the "masticatory" area into a well defined incisor or biting area "e" (stippled in the figure), and a molar or grinding process "f," which is probably formed by the crowding together of the spine-like projections of the area labeled "f," and the elongation of this area to form the molar process "f"

of textfigure 3. The black margined area from "a" to "c" becomes proportionately longer, and arches over in such a fashion that the point of attachment from "a" to "b" instead of being more horizontal as in textfigures 2 and 1, tends to become more vertical (or obliquely so) in the mandibular appendage shown in textfigure 3.

If there were any question as to whether the palpus "cn" of textfigure 3 (compare also Fig. 10, Plate VII) represents the endopodite or the exopodite of a biramous limb, a glance at Fig. 33 (Plate VIII) will readily convince anyone that the exopodite "ex" becomes reduced and is eventually lost, while the endopodite is retained to form the palpus when the palpus is present. The mandibles shown in Figs. 30 and 33 (Plate VIII) would doubtless have furnished better intermediate stages than the merostome limb used in textfigure 2 to illustrate the transition from the type shown in textfigure 1 to that shown in textfigure 3, and these forms stand more nearly in the direct line of descent of the higher Crustacea; but there are certain features which the merostome limb illustrates better than these other forms, and the figure of a merostome limb serves well enough for the purpose intended.

Since there is only what appears to be a molar area "mo" in the mandible of the branchiopod *Branchippus* shown in Fig. 23 (Plate VIII), this suggests that the molar area "mo" of Fig. 23 may represent the entire "masticatory" area of the mandible of *Apus*, shown in Fig. 22. I am more inclined, however, to think that the region labeled "in" in Fig. 22 corresponds to the incisor area "in" of Fig. 10 (Plate VI) while the closely packed processes "mo" of Fig. 22 (Plate VIII) in the proximal portion of the masticatory area, may form the molar area "mo" of Figs. 10 and 23. In this connection, it should be noted that the mandible of *Apus* assumes the position shown in Fig. 24 when "in situ," and consequently it must be turned over and placed in an upright position as in Fig. 22, if it is to be compared with the mandibles of other forms, which have assumed the latter position. The fact that the molar process "mo" is the only portion of the masticatory area preserved in the shrimp shown in Fig. 26 (Plate VIII) makes it more readily comprehensible that the molar area might be the only portion of the masticatory area preserved in the branchiopod shown in Fig. 23; but I would not insist

upon the interpretation of the area labeled "mo" in Fig. 23, as the molar area alone, and I have only provisionally interpreted it as such until I have been able to study other related forms in order to definitely determine the point in question.



Textfigure 4. Mandible of *Mysis*. Textfigure 5. Mandible of *Apsudes*.
Textfigure 6. Mandible of *Machilis*.

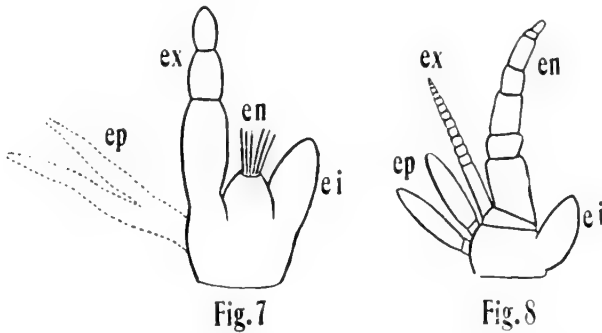
A stage beyond that represented in textfigure 3 is illustrated by *Mysis*, shown in textfigure 4 (compare also Fig. 7 of Plate VI). *Thysanopoda* or *Euphausia* would doubtless have proven to be much better in many respects than *Mysis* for such a phylogenetic study, but one must perforce do the best he can with such material as he is able to procure, and the Crustacea in question are among the number of certain interesting and much-needed specimens which I have as yet been unable to procure for study! *Mysis*, however, serves the purpose fairly well, and by comparing textfigure 4 of *Mysis*, with textfigure 3 of *Nebalia*, the following changes may be noted as we pass from the more primitive types of Crustacea to those which approach more closely to the types ancestral to the higher Crustacea, insects and "myriopods." The endopodite "en" (or mandibular palpus) becomes proportionately smaller as the basal segment of the mandibular appendage grows larger and becomes better adapted for chewing purposes. It is possible that the endopodite "en" of *Nebalia* (textfigure 3, or Fig. 10 of Plate VI) might be of some use in swimming. At any rate, it can beat outward with a movement which it would be apparently impossible for the endopodite "en"

of textfigure 4 (or Fig. 7) to execute, since the joints of the endopodite "*en*" of *Mysis* (textfigure 4) are of such a nature that the endopodite is directed mesalward instead of outward as in *Nebalia* (textfigure 3).

The black margined area from "*a*" to "*c*" is of proportionately greater extent in textfigure 4 than in textfigure 3, and arches over more pronouncedly in the former (*Mysis*) than in the latter (*Nebalia*) as may be more readily seen by comparing Fig. 7 with Fig. 10 (Plate VI). The molar region ("*f*" of textfigures 4 and 3, or "*mo*" of Figs. 7 and 10) is essentially the same in both Crustacea, but in the incisor region of *Mysis* (textfigure 4, or Fig. 7) the following parts become differentiated. The distalmost portion or apex of the mandible proper retains its character of an incisor region (labeled "*e*" in textfigure 4, or "*in*" in Fig. 7), but the processes below it (*i.e.*, "*g*" of textfigure 4, or "*gf*" of Fig. 7), called the gnathofimbrium, may assume the character of a fringe of setae-like structures, which are quite long and slender in the Crustacea shown in Figs. 4, 2, etc., of Plate VI. The function of this fringe is probably to sweep the food into the mouth cavity, or to prevent the comminuted food from falling out of the mouth when the mandibles are working. The so-called lacinia mobilis, labeled "*h*" in textfigure 4, or "*lm*" in Figs. 7, 4, etc., is probably formed by the fusion of flattened seta-like structures like those forming the gnathofimbrium below it. The articulatory region which bears the articulatory condyle near the letter "*a*" in textfigure 4 bends outward more markedly in *Mysis* (textfigure 4) than in *Nebalia* (textfigure 3) and this tendency is quite pronounced in the following stages.

In the stage of the evolution of the mandibles represented in textfigure 5 (compare also Fig. 3, Plate VI) the profile of the black-margined region from "*a*" to "*c*" is not quite so arched as in textfigure 4, and this straightening out of the arch is apparently correlated with the "upward" growth of the incisor process (*i.e.*, the stippled area in textfigure 5) which becomes long and slender in *Apscudes* (textfigure 5, or Fig. 3), *Diastylis*, and other related forms. The gnathofimbrium "*g*" of textfigure 5 (or "*gf*" of Fig. 3) is much reduced in *Apscudes* (textfigure 5), and the lacinia mobilis "*h*" of textfigure 5 (or "*lm*" of Fig. 3) is relatively small and unim-

portant in *Apseudes*. There is also a marked tendency toward the reduction of the palpus "en," and, in fact, the palpus is completely lost in the Crustacea shown in Figs. 2 and 6; and the condition exhibited by the crustacean shown in Fig. 6 (Plate VI), which has not only lost its mandibular palpus, but also has no gnathofimbrium or lacinia mobilis (i.e., the structures labeled "en," "gf" and "lm" in Fig. 3, Plate VI) is very suggestive of that exhibited by the insect representing the next stage in the evolution of the mandible.



Textfigure 7. First parapodium of *Laodice rubra* (gill "ep" is present in the second parapodium, not the first). Textfigure 8. First thoracic limb of crustacean, based on condition found in *Syncecarida*.

As was mentioned above, the mandible of the crustacean shown in Fig. 6 (Plate VI) is more like that of the insect shown in Plate VI, Fig. 5 (or in textfigure 6) than is true of the mandible of the crustacean figured in textfigure 5, since *Verbius* (Fig. 6) has lost its mandibular palpus, and has only the incisor process "in" and molar process "mo" in the distal region of the mandible—as is also true of the insect shown in Fig. 5. On the other hand, it is a very simple matter to compare the parts of the mandible of the insect shown in textfigure 6 (which is the same insect as that shown in Fig. 5, Plate VI) with the preceding crustacean stage shown in textfigure 5, and it is preferable for the sake of comparison, to use a crustacean in which the mandibular palpus is still retained, in order to demonstrate that there is no part of the insect's mandible comparable to the mandibular palpus of the crustacean.

— In comparing the mandible of the insect *Machilis* (textfigure 6) with that of the crustacean *Apseudes* (textfigure 5) it may be seen

that, as we pass over into the insectan type, the basignath, or basal region of the mandible included between the points "a," "b" and "c," becomes somewhat slenderer and more elongate, and the outline of the black-margined area from "a" to "c" is less sinuate. An impressed line extending from "b" to "c" (compare also Fig. 5, Plate VI) is continued around the other side of the mandible and demarks the basal region, or basignath, from the distal portion of the mandible, or the distignath. The secondary nature of this subdivision of the mandible, is clearly evident if we trace back the evolution of the basal segment of the mandibular limb through the various stages from textfigure 6 to textfigure 1; so that it should be patent to anyone that the mandible of the insect shown in textfigure 6 represents a *single* segment of the original mandibular appendage, and any attempt to compare the parts of an insect's mandible (which is composed of only one segment of a limb) with the parts of the "body" of an insect's maxilla (which is composed of *at least two* segments of a limb) is wholly unjustified.

The incisor process of *Machilis* (*i.e.*, the stippled region from "d" to "e" in textfigure 6) is clearly the equivalent of the incisor process of *Apseudes* (*i.e.*, the stippled region from "d" to "e" in textfigure 5), and it is consequently merely a differentiated portion of the masticatory region of the mandible of *Mysis* (*i.e.*, the region from "f" to "e" in textfigure 4) in no wise comparable to the mandibular palpus "*cn*" of textfigures 5, 4, 3, etc., as Heymons would maintain is the case with the incisor process of immature Ephemerida, nor can the incisor process of *Machilis* (*i.e.*, the stippled area from "d" to "e" in textfigure 6) be compared to the exopodite of a biramous limb (*i.e.*, "*cx*" of textfigure 1) as Wood-Mason would maintain is the case! The lacinia mobilis "*h*" and the gnathofimbrium "*g*" of the mandible of the crustacean shown in textfigure 5, are lost in the mandible of the insect shown in textfigure 6; but this is not surprising, since these structures are frequently absent even in the Crustacea themselves (*e.g.*, in the crustacean mandible shown in Fig. 6, Plate VI). The molar process "*f*" of the insect's mandible shown in textfigure 6 is clearly homologous with the molar process "*f*" of the crustacean's mandible shown in textfigures 5, 4, and 3, and is consequently merely a differentiated portion of the masticatory

surface (or the gnathobase) of the basal segment of the mandibular appendage. On this account Wood-Mason's statement that the molar process "f" of *Machilis* (textfigure 6) represents the endopodite "en" of textfigures 5, 4, 3, 2, and 1, is most astounding, and it is very difficult to understand how anyone who has studied the Crustacea at all, could come to such an unwarranted conclusion.

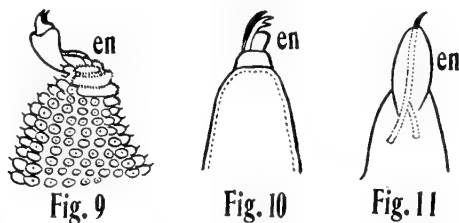
INTERPRETATION OF PARTS OF AN INSECT'S MANDIBLE.

From the foregoing discussion, it should be evident that an insect's mandible represents only one segment of the original limb forming the mandibular appendage of trilobites, Crustacea, etc., and neither the exopodite "ex" of textfigure 1, nor the endopodite "en" of textfigures 1, 2, 3, 4, and 5, are represented in the mandible of an insect. Furthermore, the division of *Machilis*' mandible into a basal region or basignath, and a distal region or distignath, by the suture from "b" to "c" in textfigure 6, is a purely secondary one, and in fact is foreshadowed in the mandibles of certain Crustacea such as our common southern shrimp (and a hint of this division is shown in the mandible of the crustacean *Ligia*—see Fig. 36, Plate VIII).

The evolution of the mandibles shown in textfigures 1, 2, 3, 4, and 5, is in complete agreement with the relative positions assigned the arthropods in question from their general anatomical features, and I do not see how anyone can deny that the series in all probability represents the stages through which a specialized mandible such as that of *Apscudes* (textfigure 5) has passed in assuming its present condition. We are therefore justified in assuming that the mandible proper (*i.e.*, exclusive of the palpus) of Crustacea is composed of one and only one segment of the original mandibular appendage; and if we compare the tentorio-basignathal muscles attached to the basal region (basignath) of *Machilis*' mandible (Fig. 5, Plate VI) with the muscle attached to the base of the mandible of the crustacean shown in Fig. 2 (Plate VI) it is evident that the muscles are practically the same—consequently the regions to which they are attached are homologous, and the apparent basal segment of *Machilis*, mandible (Fig. 5) is therefore merely the basal region of the mandible of the crustacean shown in Fig. 2, *which is composed of only one segment*. It follows from this, that the subdivision of the mandible of *Machilis* is

purely secondary, and I am of the opinion that the apparent segmentation of the mandibles of "myriopods" is also purely secondary.

As we trace the modifications of the mandibles from textfigure 6 back to textfigure 1, it is evident that the incisor process (*i.e.*, the stippled area in textfigure 6) and the molar process "*f*" of the insect's mandible shown in textfigure 6 are merely differentiated portions of the gnathobase "*gb*" of the basal segment of the biramous



Textfigure 9. Diagram of limb of *Peripatus*. Textfigure 10. Diagram of limb of a tardigrade based on *Macrobiotus*. Textfigure 11. Diagram of limb of a myzostomarian such as *Myzostoma cirriferum*.

mandibular limb shown in textfigure 1. If the lacinia of an insect's maxilla represents the endite or gnathobase "*ci*" of one segment of a mouthpart limb ultimately derived from a primitive limb of the type shown in Figs. 20 and 19 (Plate VII), while the galea of the maxilla represents the endite "*ci*" of another segment of such a limb (as I am hoping to demonstrate is the case, in a later article), then the incisor region and molar region together (*i.e.*, the differentiated portions of a gnathobase) of an insect's mandible would correspond to the lacinia (*i.e.*, a modified endite or gnathobase) of the maxilla. If this is true (as I am convinced is the case) it is absurd to attempt to homologize the small lacinia mobilis "*h*" (textfigure 4) of an insect's mandible (in other words, a small appendage of the gnathobase region formed by the fusion of a few setæ or spines) with the entire lacinia of an insect's maxilla (*i.e.*, with an entire gnathobase or endite) as is done by Chatin, and many other entomologists who are apparently ignorant of the true character of the parts they seek to compare.

The incisor region "*c*," the lacinia mobilis "*h*," the gnathofimbrium "*g*" and the molar region "*f*" of the crustacean mandible shown in textfigure 4 are all represented in the mandibles of certain

insects. The so-called prostheca of the mandibles of certain insects is possibly the homologue of the lacinia mobilis "*h*" of the mandible shown in textfigure 4, and from the discussion given above, it should be evident that it is impossible to homologize the prostheca or lacinia mobilis of an insect's mandible with the lacinia of an insect's maxilla, since the whole gnathobase, inclusive of the region from "*f*" to "*e*," of the segment forming the mandible shown in textfigure 4 is probably homologous with the whole gnathobase (or endite) which forms the lacinia of one of the segments entering into the composition of the body of the maxilla of an insect. If entomologists could only be brought to realize that the entire masticatory portion from "*f*" to "*e*" of a mandible such as that shown in textfigure 4 represents merely an area of one gnathobase (or endite) of one segment of a limb such as "*gb*" of textfigure 1, or "*gb*" of Fig. 20 (Plate VII), and that the lacinia of the maxilla represents a similar entire endite "*gb*" or "*ci*" of one segment of a limb such as that shown in Figs. 20 and 19, while the galea of the maxilla represents a second endite "*ci*" of another segment of such a limb (the terminal portion of the limb forming the maxillary palpus), there would not be such absurd proposals put forward as some of the interpretations of the parts proposed by Chatin,¹ Smith, Packard, Hollis, Wood-Mason, and others who have attempted to interpret the structure of insects' trophi in terms of crustacean anatomy.

The study of the modifications met with in the Crustacea has amply repaid the time spent upon it, and I would emphasize the fact that it is the Crustacea (not the Myriopoda) which have in each case

¹ Among other purely fanciful interpretations of the parts of the mandible of insects, Chatin, 1884, refers to "*une ébauche de palpe*" in the mandibles of certain staphilinid beetles, apparently influenced by the suggestion of Hollis, 1871, who regards the prostheca of the mandible of certain staphylinids, etc., as the representative of the mandibular palpus of Crustacea. Wood-Mason, 1879, has also developed the idea that the prostheca, or the lacinia mobilis of beetles represents the endopodite of a nauplius limb (Crustacea), and Eaton, 1883, in his "*Monograph of the Ephemerida*" refers to the lacinia mobilis of the mandibles of immature may-flies as the representative of the endopodite of a formerly biramous limb. These and many similar misinterpretations of the parts of the mandible clearly show that it is necessary to study the evolution of the mandibular appendage in Crustacea, in order to properly interpret the parts of the mandible in insects.

furnished the key to the interpretation of the parts in insects; and, in fact, it is absolutely essential that anyone who desires to give the correct interpretation to the various structures of insects, and who wishes to determine the phylogenetic origin of insects, should give as much time as he is able to the study of the evolution of the parts in Crustacea, which have departed as little as any known forms from the types of arthropods ancestral to the "Myriopoda" and Insecta.

Machilis is an insect which is structurally much more primitive than most entomologists realize, and instead of being a degenerate winged insect as Handlirsch would have us believe, I would insist that it is absolutely primitive in most respects, and has departed in fact but little from the condition characteristic of some of the ancestral insects. It has even preserved certain characters suggestive of affinities with the primitive Collembola—although its closest affinities are with the *Lepisma*-like Apterygota, and it furnishes us with a connecting link anatomically annectant between the Crustacea and the *Lepisma*-like types, as well as with the lowest representatives of the winged insects such as nymphal Ephemera, etc. In fact, the mandibles of *Machilis* (and to some extent of certain immature ephemerids also) are more like the mandibles of Crustacea than they are like the mandibles of other insects (as is likewise true of the muscles attached to the mandibles of *Machilis*) and a study of the anatomical details of *Machilis* (and of nymphal ephemerids also) is absolutely essential in making an attempt to trace the evolution of the insectan type of arthropod. On this account, I have used *Machilis* to illustrate the probable mode of origin of one type of insectan mandibles; but it is also necessary in such a study to trace the origin of the type of trophi found in the Dicellura (*Japyx*, *Campodea*, etc.) as well, since the dicelluran type is one of the primitive types of insects as well as *Machilis*; but the Dicellura are of less importance despite their remarkable resemblance to the Symphyla (e.g., *Scolopendrella*, etc.) since their line of development, in paralleling that of the Symphyla, leads away from the main path of development followed by winged insects (as exemplified by immature ephemerids) and higher Crustacea, along a line of specialization having no particular bearing upon the developmental tendencies of insects in general. *Machilis*, *Lepisma*, and *Nicoletia*, on the other hand, exhibit

many tendencies carried over into winged insects through the ephemerid and plecopteran types, and since *Machilis* is the most primitive of these forms, it will serve as the starting point for the next of the series of papers in which it is proposed to trace the modifications of the mandibles met with in insects in general.

TYPES OF CRUSTACEAN MANDIBLES.

Since the Crustacea form the connecting link between the lower arthropods and the insectan and myriopodan types, it may be of some interest to note the modifications met with in the more important groups of Crustacea, which might throw some light upon the conditions occurring in the mandibles of insects. The condition met with in the mandibles of the lower forms such as the Copepoda (Fig. 30), Ostracoda (Fig. 33) and Branchiopoda (Figs. 22 and 23) is too far removed from the insectan type to be of much interest from this standpoint, especially since the incisor and molar regions are not clearly differentiated in these lower Crustacea. Similarly, the mandible of *Nebalia* (Fig. 10) is still too primitive to be of much value in such a study. *Mysis* (Fig. 7) on the other hand has approached sufficiently close to the type ancestral to insects, to exhibit a number of features such as the differentiation into incisor region proper, gnathofimbrium, and molar region, and the development of a lacinia mobilis, all of which are present in some insects. The mandibular palpus, however, is still very large in proportion to the size of the mandible proper.

In such Crustacea as *Stegoccephalus* (Fig. 4) there is a pronounced reduction of the palpus "*cn*," while the incisor region "*in*" becomes slenderer and more elongate, and the gnathofimbrium "*gf*" is of greater extent and is composed of seta-like structures forming a hair-like fringe rather than a cluster of spine-like projections as in *Mysis* (Fig. 7). In the species of *Asellus* shown in Fig. 1, the mandibular palpus "*cn*" is quite reduced; but the incisor region "*in*" is not quite as long as in *Stegoccephalus* (Fig. 4). The gnathofimbrium "*gf*" is of somewhat less extent than in Fig. 4, and the reduction of the gnathofimbrium "*gf*" is carried still further in Fig. 3.

In *Diastylis* (Fig. 2) the mandibular palpus has completely disappeared, and the incisor process is rather slender and greatly

elongate. The gnathofimbrium "*gf*" is well developed and is composed of flattened seta-like processes. The lacinia mobilis "*lm*" is somewhat reduced, but is still of a different character from the seta-like components of the gnathofimbrium "*gf*," although in the mandibles shown in Figs. 1 and 3, the lacinia mobilis "*lm*" does not differ greatly from the structures composing the gnathofimbrium "*gf*."

In the decapod shown in Fig. 6, the mandibular palpus has become atrophied, and the beginning of the process is shown in the decapod depicted in Fig. 35, in which the mandibular palpus "*en*" is merely a small rudimentary appendage of the greatly developed mandible proper. The incisor process "*in*" of the decapod shown in Fig. 6 is not very large, and it has completely disappeared in the decapod shown in Fig. 26, which has retained only the molar process "*mo*" of the distal structures of the mandible. The gnathofimbrium and lacinia mobilis have apparently not developed in the decapod types of Crustacea, though *Mysis* (Fig. 7) which resembles *Thysanopoda*, *Euphausia*, and other forms related to the Decapoda, has acquired a lacinia mobilis "*lm*," and a primitive sort of gnathofimbrium "*gf*."

In the mandible of *Squilla* (Fig. 28) the palpus "*en*" is very small, and the structure which I have interpreted as the molar process "*mo*" is folded back in a peculiar fashion. The incisor region "*in*" is continued basalward in a region which may be the precursor of the gnathofimbrium of higher forms. At any rate, the incisor surface is of greater extent than in the higher forms.

In the mandibles shown in Figs. 25 and 32, there is a peculiar gnathofimbrial lobe "*gf*," and the molar process "*mo*" has taken on a peculiar form, and is somewhat folded around in a fashion suggestive of the process which has been carried to an extreme in the molar process "*mo*" of Fig. 28. Just above the base of the mandibular palpus "*en*" in Fig. 25, is a small protuberance which is produced into two tooth-like processes just above the base of the cut-off mandibular palpus in Fig. 32. These tooth-like processes may be the precursors of the elongate incisor "tusks" of the mandibles of certain ephemerid nymphs, or a process of the region "*in*" of Fig. 4 forms the tusk-like process of the mandibles of ephemerid nymphs.

The mandible of a male of *Gnathia* (Fig. 27) resembles the

mandibles of certain insects in having no palpus, or molar region differentiated from the incisor region. On the other hand, the mandible of *Caprella* resembles that of certain insects in having a short molar protuberance "mo," and a shorter and stouter type of mandible than is present in many Crustacea. The tendency toward a shortening of the mandible is also exhibited by *Ligia* (Fig. 36) and other isopods, and the molar process "mo" becomes blunter and stouter in *Ligia*. Through a further shortening and through the reduction of the basignath, or basal region of the mandible shown in Fig. 36, the type of mandible found in certain pterygotan insects might easily be derived, and the question naturally arises as to whether the small sclerite called the basimandibula (or the "trochantin" of the mandible) which is situated at the base of the mandible in certain orthopteroid insects, may not correspond to the demarked basal region of a mandible such as that shown in Fig. 36, in which there is a slight indication of a division of the mandible into a basal and a distal portion by the transverse dotted line shown in the figure. While I would not deny the possibility of such an explanation of the basimandibula (or mandibular "trochantin") in insects, I am more inclined to regard the formation of this basal sclerite or basimandibula as the result of a chitinization of the articulatory membrane at the base of the mandible in insects.

RELATIONSHIPS INDICATED BY MANDIBULAR APPENDAGE.

As was stated at the beginning of this paper, the mandibles alone can furnish but a small portion of the evidence of relationship, which must be drawn from as many sources as possible, and should include not only the study of anatomical details, but also that of the embryological development of the forms in question, as well as their habits, immature stages, and all other features having a direct bearing upon the subject. Taken in connection with these other features, however, the nature of the mandibular appendage in the various arthropodan groups is of considerable value in determining the lines of development and the interrelationships of these groups, and it may be of interest to point out some of the indications of relationship between certain of the groups furnished by an examination of the mandibles.

The character of the mandibular limb (or any of the mouthpart

limbs) of a trilobite such as that shown in Fig. 9 is more like that of the mouthpart limbs of the merostomes (Figs. 12, 8, etc.) than it is like the mandible of a crustacean, as was pointed out above, and in addition to the similarity in the head region, and in the body segmentation and the pygidial region of an immature merostome such as *Limulus* and certain of the Trilobita, this resemblance might justify our grouping the trilobites with the merostomes, etc., in the subphylum "Podognathata," rather than with the Crustacea and their allies, in the subphylum "Eugnathata." The gnathobase "*gb*" of a trilobite such as that shown in Fig. 18 is very similar to the gnathobase "*gb*" of the merostome shown in Fig. 12, and the appendage homologous with the mandibular appendage of Crustacea, etc., is more like a walking leg in the trilobites, merostomes, and their allies, than it is like a true mandible (such as the mandible of a crustacean), so that the evidence of the mandibular appendage of trilobites and merostomes would indicate a somewhat closer relationship between these two groups than between the trilobites and Crustacea, although the trilobites are clearly intermediate between the Crustacea and Merostomata, and are but slightly nearer the one than the other.

In the eurypterid shown in Fig. 17, there is a small appendage "*ci*" called the "epicoxite" by Clarke and Ruedemann, 1912, which is situated immediately below the gnathobase "*gb*" of the fourth "endognathite" (or mesal region of the basal segment of the limb) according to Clarke and Ruedemann. In the limb of the xiphosuran *Limulus* shown in Fig. 14, I find a similar structure "*ci*" situated below the gnathobase "*gb*," and if the structure "*ci*" of Fig. 14 is homologous with that labeled "*ci*" in Fig. 17 (as seems to be the case) the presence of this peculiar structure in both eurypterids and xiphosurans would further strengthen the view that the two groups are extremely closely related.

Since the Scorpionida are apparently descended from forms resembling the Eurypterida and other merostomes, I have tried to find the homologues of the gnathobases "*gb*" of Figs. 15 and 12, in a scorpion's limb and I would suggest that the small projection labeled "*gb*" in the basal segment of the limb of the scorpion shown in Fig. 16 may correspond to the gnathobases "*gb*" of Figs. 15 and 12.

The gnathobases "*gb*" of the merostomes shown in Figs. 12 and 16 are clearly homologous with the gnathobases "*gb*" of the trilobites shown in Figs. 18 and 9, since in each instance the gnathobase is formed by a mesal prolongation of the entire basal segment of the limb. On the other hand, the so-called gnathobases "*gb*" of certain Crustacea such as those shown in Figs. 13 and 21, appear to be slightly different outgrowths or appendages of the segment; and in the crustacean shown in Fig. 20, the endites "*ei*" of the several segments of the limb, which are homologous with the gnathobase or endite labeled "*gb*" in the basal segment, have taken on the appearance of segmented appendages of the segments rather than mesal prolongations of the entire segment—although it must be admitted that the endite "*gb*" of the basal segment of the limb shown in Fig. 20, approaches more closely to the trilobitan type of gnathobase ("*gb*" of Fig. 18). The greater similarity between the gnathobases of trilobites and merostomes (*i.e.*, "*gb*" of Figs. 18, 15, and 12) than between the gnathobase of trilobites and the endites of Crustacea in general (compare "*gb*" of Fig. 18 with "*gb*" of Figs. 21 and 13, or "*ei*" of Figs. 19 and 20), however, would tend to throw the trilobites slightly nearer the merostomes than the Crustacea, when taken into consideration with certain other features of resemblance in the groups Trilobita and Merostomata.

As was remarked above, the mandibles of the Branchiopoda (Figs. 22 and 23) are not very much like the mandibular appendage of trilobites (Fig. 9) despite the close relationship between the two groups; but the mandibles of the Copepoda and Ostracoda (Figs. 30 and 33) have still retained both the exopodite "*ex*" and the endopodite "*en*" of a typical biramous limb (Fig. 9, "*ex*" and "*en*"), and it would appear that the masticatory portion of the mandible of the Crustacea shown in Figs. 30 and 33 represent true gnathobases "*gb*" of a trilobitan limb (Fig. 9) since the structures in question are mesal prolongations of the entire basal segment in both instances. I would therefore maintain that the Copepoda (and the Ostracoda also) are quite closely related to the Trilobita, although the former belong to the subphylum "Eugnathata" in which the mandibles have passed beyond the walking-leg stage and have become true jaws; while the trilobites appear to be somewhat more closely associated with the subphylum "Podognathata" in which the appendage homo-

logous with the mandibles of Crustacea are more limb-like, or are not of the true "jaw" type.

The fact that the incisor process "*in*" of *Nebalia* (Fig. 10) is but weakly developed, and the differentiation of the masticatory region is consequently not so marked as in the higher forms, would indicate that *Nebalia* is a comparatively primitive type but little higher than the Branchiopoda, Copepoda, etc.; while the fact that *Nebalia* exhibits a marked tendency toward a differentiation of the masticatory area and the development of an incisor process (even though a feeble one), shows that *Nebalia* is structurally intermediate between the lower Crustacea and the more modified forms, as is borne out by the character of the body in general. The great size of the mandibular palpus (in comparison with the size of the basal segment of the limb which forms the mandible proper) and its apparent ability to function in locomotion, is another feature indicating the comparatively primitive character of *Nebalia*, and the evidence of the mandible is in full accord with other indications of the intermediate position of *Nebalia* as a form connecting the lower Crustacea (Branchiopoda, Copepoda, Ostracoda, etc.) with the more modified types. *Nebalia* has not developed a lacinia mobilis (and gnathofimbrium), and on this account the absence of a lacinia mobilis in the mandibles of certain Crustacea may possibly be regarded as somewhat more primitive condition than is the case with those Crustacea in which the lacinia mobilis is developed.

The Euphausiacea, such as *Thysanopoda*, are very primitive types related to the Decapoda, and since both of these orders have not developed a lacinia mobilis (see Fig. 35) in the mandible (and the gnathofimbrium is usually lacking also), this fact would support the view that the Decapoda and Euphausiacea are quite closely related. The Stomatopoda such as *Squilla* (Fig. 28) are rather primitive forms in some respects, and their mandibles also lack the lacinia mobilis as in the Euphausiacea and Decapoda, which they resemble in certain other anatomical features as well.

The Mysidacea such as *Mysis* (Fig. 7) have developed a lacinia mobilis "*lm*," and a primitive sort of gnathofimbrium "*gf*," and in this respect they resemble the Cumacea (Fig. 2), Tanaidacea (Fig. 3), Isopoda (Figs. 1 and 36) and related forms, as was first pointed out

by Boas, 1882. Calman and other recent carcinologists have removed the Mysidacea from the old order Schizopoda which also included the Euphausiacea, etc., and have grouped the Mysidacea with the Cumacea, Tanaidacea, Isopoda, etc., because of the presence of the lacinia mobilis (among other features) in these forms and its absence in the Euphausiacea and Decapoda. I cannot avoid the conclusion that the Mysidacea are much nearer the Euphausiacea, however, despite these facts, although the Mysidacea are evidently intermediate between the Euphausiacea on the one side, and the Cumacea, Tanaidacea, Isopoda, etc., on the other. It is thus a matter of determining the closest affinities of the Mysidacea and not a question of their intermediate character, which is to be decided; and while the evidence of the mandibles would support the view that the Mysidacea are somewhat nearer the Cumacea, Tanaidacea, etc., I am by no means satisfied that other points of resemblance between the Mysidacea and Euphausiacea are not of greater importance.

The mandibles of the Syncarida such as *Anaspides* have no lacinia mobilis; but a gnathofimbrial lobe very suggestive of that shown in Fig. 25, "*gf*," occurs on the mandible of *Anaspides*, and, contrary to the opinion of Calman, I would maintain that the Syncarida are nearer the types ancestral to the Tanaidacea, Isopoda, etc., than they are accredited to be by Calman and other carcinologists. In fact, it is quite probable that the common ancestors of the Tanaidacea, Isopoda, Amphipoda, Insecta and Symphyla, etc., were anatomically intermediate between the Syncardia on the one side, and the Mysidacea on the other and were related to the Arthropleura and Oxyuropoda as well; but this matter will be discussed more at length in a later paper.

The mandible of a cumacean such as *Diastylis* (Fig. 2) bears a well developed gnathofimbrium "*gf*" and a lacinia mobilis "*lm*," and in the development of its incisor process, it resembles *Apseudes* (Fig. 3). The Cumacea are regarded by Calman as intermediate between the Mysidacea and the isopod type of higher Crustacea, and a study of the mandible would lend weight to this view. On the other hand, the Cumacea are such highly aberrant forms, that they do not furnish any very valuable clues as to the phylogeny of the higher Crustacea. Their type of mandible, however, is as near that

of the Tanaidacea, Isopoda and Amphipoda as any, and it is more logical to group them with these forms than to place them lower in the scale of development than the Mysidacea, as was formerly done by the earlier carcinologists.

The mandibles of the Isopoda (Figs. 1 and 36) and Tanaidacea (Fig. 3) are remarkably similar, and both are very like those of the Amphipoda (Fig. 4), and the resemblance on the part of the mandibles thus further substantiates the evidence of a very close relationship between these groups drawn from other sources. All of these groups are apparently closely related to insects, and with the exception of the presence of the mandibular palpus, the types of mandibles occurring in these forms are approached by the mandibles of certain insects some of which are members of even so high a group as the Pterygota. It would thus appear that certain hereditary impulses from the Crustacea have surged upward, so to speak, through the apterygotan lines of descent and have penetrated well into the lines of descent of the pterygotan insects before losing their force and becoming so greatly modified as to be no longer recognizable as crustacean features.

It should be borne in mind, that there are several types of mandibles present in insects, which can be traced back to crustacean types, and the type of mandible shown in textfigure 6 (which was probably derived from the crustacean type shown in textfigure 5) is only one of these. The type of insectan mandible shown in textfigure 6, however, is so much like that of the crustacean shown in textfigure 5, that it is almost more crustacean than it is insectan, despite the fact that the insect (*Machilis*) to which it belongs, is indisputably an "out-and-out" hexapod. The character of the head and its appendages (Maxillary palpus, etc.) in *Machilis*, the nature of its body, and many other features than its mandibles alone, proclaim its close relationship to the Crustacea; and if *Machilis* is nothing but a degenerate winged insect (instead of being a very primitive type near the ancestors of winged insects) as Handlirsch, 1909, would have us believe, then the Crustacea, to which *Machilis* is so closely related, must also be regarded as degenerate winged insects (!) because *Machilis* is anatomically much nearer the Crustacea than winged insects are—and if this be a sign of degeneracy, then the Crustacea must be degenerate winged insects also.

I suspect that Handlirsch's overweening desire to derive winged insects directly from trilobites is the cause of his attempt to deny to *Machilis*, *Lepisma* and related *Apterygota* their rightful positions as the nearest known representatives of the *precursors* of winged insects, and to relegate them to the subordinate position of mere "degenerate" winged insects, for there is a wide gap between these *Apterygota* and the trilobites and they do not seem to approach the trilobitan type any more closely than the winged insects themselves do—and if winged insects are to be derived directly from trilobites, their precursors must perforce resemble trilobites more closely than winged insects do! Therefore, in order to maintain his unfounded theory that winged insects are descended directly from trilobites, it was necessary for Handlirsch to sweep the true ancestral types of insects aside as degenerate winged insects, since they do not fit into his preconceived scheme of the origin of pterygotan insects. As an anatomist, however, I cannot avoid the conclusion that such *Apterygota* as *Machilis*, *Lepisma*, *Nicoletia*, *Campodea*, etc., are far more primitive than winged insects (as is also shown by the embryological development of these forms) and if the facts of the case do not fit into one's theory, it is much better to discard the theory and stick to the facts!

I have perhaps laid greater emphasis upon Handlirsch's views as to the origin of winged insects, than should be given to a theory which was evidently developed merely as a side issue of his monumental work on fossil insects; but so many recent writers, who have not taken the trouble to go into the matter at all deeply, have set forth this unfounded view of Handlirsch's (even in text-books) as though it were absolutely demonstrated, that it is high time that someone should call attention to the many obstacles in the way of accepting such a view. There are many other insuperable obstacles to the acceptance of the view that winged insects (or even the most primitive of the apterygotan types which preceded winged insects) may be derived directly from trilobites; but since this paper deals with the mandibles alone, I shall confine myself to the evidence offered by these structures—which is quite sufficient in itself to disprove Handlirsch's theory, since the mandibles clearly indicate that there must have been a great number of intermediate stages between so primitive

a type as the biramous mandibular limb shown in textfigure 1 and the greatly modified single segment of such a limb which forms the mandible of the primitive insect shown in textfigure 6.

Let us for a moment consider the tremendous changes involved in such a leap directly from the type of mandibular limb shown in textfigure 1 to the type of mandible shown in textfigure 6, without reference to any of the intermediate stages of the series at whose extremes these types stand. The most "spectacular" change would be the immediate loss of the exopodite "*ex*" and the endopodite "*en*" which are better developed in trilobites than in other arthropods, and represent the extreme of primitiveness as exhibited by the trilobite's mandibular limb. The endopodite "*en*" is relatively larger and better developed in trilobites than is shown in textfigure 1 (compare with correct proportions shown in Fig. 9 of Plate VI) and it still functions as a locomotor appendage in these forms. That such a well developed, perfectly functioning, and apparently useful structure as this endopodite (which is wholly wanting in all insects) should suddenly and completely disappear without first *gradually* becoming reduced to fewer segments and losing its importance as a functioning organ of any value (as is shown in the complete series from textfigure 1 to textfigure 6) is extremely improbable, to say the least; and it would require more of a mutational leap than even the famous *Drosophila* has been able to execute, to accomplish "all in one fell swoop" not only the loss of the exopodite and greatly developed endopodite, but the profound modification and intricate differentiation of the parts of the basal segment which would transform the gnathobase of a trilobite into the highly specialized mandible of an insect!

It should be borne in mind that textfigure 1 is a diagram pure and simple, and consequently the trilobite's gnathobase "*gb*" as shown in textfigure 1 is not as much differentiated as the diagram would indicate (since the series shown in the textfigures is intended to emphasize certain points of development thereby making it more readily comprehensible as to how the changes have probably taken place); and, as one may see by referring to Fig. 9 (Plate VI) the basal segment of the mandibular limb is still comparatively small in the trilobite, and its gnathobase "*gb*" merely bears a few spine-like pro-

jections. It is a considerable leap from such a condition even to the weakly developed type of mandible shown in textfigure 3 (which is infinitely more primitive than any insect's mandible), since in the latter form, there is a small incisor process "c" distinct from the molar process "f" (neither of which are present in the trilobite), and the basal segment of the limb has begun to take on a contour suggestive of a mandible—while the basal segment of the trilobite's mandibular limb is just like the basal segment of its "walking" legs; and the leap from such a basal segment to one of the mandibular type bearing not only an incisor process, but a lacinia mobilis, molar process, and other complicated structures, such as occur in the mandibles of immature ephemerids (whose mandibles are the most primitive of any winged insect thus far studied) involves such profound and fundamental changes in structure, that if we had only the evidence of the mandibles alone, to judge from, it would be impossible to justify Handlirsch's impossible claim that winged insects (or even the far more primitive apterygotan insects) were derived directly from trilobites; and it is indeed astounding that such revolutionary claims have been so readily accepted by scientific men who are usually more than "conservative" in accepting new views which are not demonstrated by almost irrefutable facts!

The nature of the mandibular appendages, in addition to the evidence drawn from many other sources, would indicate that the "higher" Crustacea, (*i.e.*, Amphipoda, Isopoda, Tanaidacea, etc.) together with the Insecta and Symphylo-Pauropoda, were in all probability derived from common ancestors anatomically intermediate between the Mysidacea on the one side and the Syncarida on the other, and these common ancestral types were probably also related to the Arthropleura and *Oxyuropoda* as well. Starting from this common source, the lines of descent of the Insecta were paralleled on one side by the "higher" Crustacea, and on the other by the lines of descent of the Symphylo-Pauropoda. The symphylian line of development paralleled that of the Insecta only as far as the point where the Dicellura (*Campodea*, *Japyx*, etc.) were developed, whereupon the lines of development of the Symphyla and the Dicellura appear to become specialized in a direction which does not lead to the production of types approaching the winged insects. On the other hand, the

lines of descent of the higher Crustacea appear to parallel that of the insects for a much longer distance, even until the lower forms of winged insects were developed, since many crustacean characters are carried over into the lower types of winged insects such as the Ephemera, etc. The study of the anatomical features of the Crustacea is therefore of much greater importance than that of the "myriopods," and in the foregoing discussion, it has been shown that at least one type of insectan mandible has been derived more or less directly from a type occurring in the Crustacea. The derivation of the other types of mandibles occurring in insects will be discussed in a second paper of this series, in which it is proposed to take up the evolution of the modifications met with in the different orders of insects as well.

SUMMARY.

The principal points brought out in the foregoing discussion may be briefly summarized as follows:

1. The parapodium of an annelid represents the probable precursor of the primitive biramous arthropodan limb, which in turn is the forerunner of the mandibular appendage of Crustacea, Insecta, and "Myriopoda."

2. Insects, myriopods, and Crustacea form a subphylum (the Eugnathata) in which the mandibular appendage is essentially jaw-like rather than limb-like. In the rest of the Arthropoda (which constitute the subphylum Podognathata) the limbs homologous with the mandibular appendage are not jaw-like, and trilobites appear to be slightly nearer the latter group than the former, although they are anatomically intermediate between the two groups.

3. The biramous mandibular appendage of trilobites, in which both exopodite and endopodite are retained, and in which the basal segment of the limb has become slightly modified for holding food through the development of a gnathobase, while the rest of the appendage still serves a locomotor limb, forms the starting point for tracing the modifications met with in the mandibular appendage of Crustacea, Insecta and "Myriopoda."

4. The first steps in the production of a true mandible from such an appendage are the loss of the exopodite, and the reduction of the endopodite to a mandibular palpus, accompanied by the greater de-

velopment of the basal segment of the mandibular appendage to form the body of the mandible proper, and the differentiation of the masticatory surface of the gnathobase into an incisor and a molar area.

5. In the mandibles of the Mysidacea and higher Crustacea, a lacinia mobilis is formed in the incisor region (*i.e.*, the region distal to the molar process) through the fusion of several hair-like or spine-like structures similar to those which form the so-called gnathofimbrium or bordering fringe of the region of the mandible immediately beyond (distal to) the molar process. These structures also occur in the mandibles of insects, but the homologue of the mandibular palpus of Crustacea has never been found in any insect thus far described.

6. The mandible of *Machilis* represents one type of insectan mandible which is even more crustacean than insectan in appearance, and the derivation of this type of mandible from a crustacean precursor involves so slight a change, that the evidence drawn from a study of the mandibles is in full accord with that drawn from other sources, which indicate that the Crustacea probably represent the forms ancestral to insects.

7. The character of the mandible of *Machilis* indicates that it is a very primitive form, and the many crustacean features preserved by *Machilis* clearly indicate that it is a much more primitive insect than it is generally supposed to be. This insect is anatomically annectant between the Crustacea and such apterygotan insects as *Lepisma*, *Nicoletia*, etc., which in turn lead to the lower types of winged insects such as the Ephemera, and through them and the Plecoptera to the remainder of winged insects. There is no reason whatsoever for the unfounded claim that *Machilis* is a degenerate winged insect, and it approaches the crustacean type so closely that if *Machilis* is to be regarded as a degenerate winged insect, then the Crustacea must also be regarded as degenerate winged insects.

8. It is utterly impossible to derive any insectan type of mandible directly from the trilobitan type of mandibular appendage, since the immediate loss of the exopodite and the endopodite (which still functions as a locomotor appendage in trilobites), the immediate assumption of the mandibular form by the comparatively simple basal segment

of the trilobite's mandibular limb, and the immediate differentiation of its gnathobase into a highly complicated apparatus including a specialized incisor region, a lacinia mobilis, a gnathofimbrium, and a specialized molar process, involve too profound and far reaching changes to be accomplished save by a gradual process of evolution involving a long series of intermediate stages.

9. The Crustacea not only approach the insectan type astonishingly closely, but they also furnish us with a long series of intermediate stages connecting the insectan types of structures with the lower arthropodan forms, such as the Trilobita. Furthermore, they not only furnish excellent connecting links between the Insecta and lower arthropods, but they are the *only forms* which furnish these intermediate types leading from the lower arthropods to the Insecta, and this fact is one which cannot be ignored in attempting to determine the character of the ancestors of insects.

10. The Crustacea not only furnish the intermediate stages leading from the lower arthropods to the insectan type, but they also furnish us with the key to the proper interpretation of the homologies of the various insectan structures, and they enable us to clear up many of the false views concerning the meaning of the parts of the mandibles as well as other structures of insects. Thus, a study of the evolution of the mandibular appendage in the Crustacea clearly shows that the incisor region, the lacinia mobilis, the gnathofimbrium and the molar process are merely differentiated portions of the masticatory surface of a gnathobase or endite, while a similar study of the appendages homologous with the maxillæ of insects indicates that the lacinia represents a complete endite (or "gnathobase") of one segment of a limb, while the galea represents a second endite of another segment of the limb, whose terminal segments form the maxillary palpus. It is thus impossible to homologize the lacinia mobilis of the mandible with the lacinia of the maxilla in insects; and since the mandible represent only one segment with its gnathobase, while the body of the maxilla represents at least two segments with their endites (or gnathobases) it is obviously incorrect to claim that the parts of the maxilla are repeated in the mandible, as is done by many entomologists.

11. A study of the mandibles, in connection with other features, would indicate that insects arose from ancestors which were an-

atomically intermediate between the Mysidacea and the Syncarida, and were also in all probability related to the Arthropleura and to *Oxyuro-poda* as well. From this common ancestry arose the higher Crustacea, whose lines of development have paralleled that of insects on one side, and the Symphylo-Pauropoda, whose lines of development have paralleled that of insects on the other side. The lines of development of the higher Crustacea have accompanied those of the insects much further than the lines of development of the Symphyla, etc., have, and many crustacean features have even been carried over into the lower representatives of the winged insects.

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ABBREVIATIONS.

- a* Basal condyle; "a" and "b" denote limits of points of attachment of mandible.
- b* "a" and "b" denote extent of basal attachment of mandibular appendage.
- bg* basignath, or basal region of mandible.
- c* distal limits of basignath on outer surface of mandible.
- ci* appendage called epicoxite in merostome gnathobase.
- d* point at base of incisor process.
- dg* distignath, or distal region of mandible.
- e* apex of mandible.
- ei* endites, or gnathobase (also called endognathite); ventral cirrus of annelid parapodium.
- en* endopodite or inner branch of biramous limb; main axis of annelid parapodium.
- ep* epipodites or gills.
- ex* exopodite or outer branch of biramous limb; dorsal cirrus of annelid parapodium.
- f* molar process.
- g* gnathofimbrium.
- gb* gnathobase or endite of basal segment of limb.
- gf* gnathofimbrium, or marginal fringe in distal region of mandible.
- h* lacinia mobilis or epignath.
- in* incisor process or incisor region (incisorium).
- lm* lacinia mobilis or epignath.
- mo* molar process or mola.

EXPLANATION OF PLATES VI, VII, VIII.

Unless otherwise specified, all figures represent posterior views of right mandibular appendage so oriented that apex is directed toward the top of the page, and region normally bearing endopodite or palpus, is directed toward the left-hand margin.

PLATE VI.

- Fig. 1. Mandible of *Asellus communis* (Isopod Crustacea).
 Fig. 2. Mandible of *Diastylis* sp. (Cumacean Crustacea).
 Fig. 3. Mandible of *Apseudes spinosus* (Tanaidacean Crustacea).
 Fig. 4. Mandible of *Stegocephalus* sp. (Amphipod Crustacea).
 Fig. 5. Mandible of *Machilis* sp. (Apterygotan Insecta).
 Fig. 6. Mandible of *Verbius zostericola* (Decapod Crustacea).
 Fig. 7. Mandible of *Mysis stenolepis* (Mysidacean Crustacea).
 Fig. 8. Swimming leg of young *Limulus polyphemus* (Xiphosuran Merostomata).
 Fig. 9. Mandibular appendage of opisthoparian trilobite, *Triarthrus becki*, based on figure by Raymond.
 Fig. 10. Mandible of *Nebulia bipes* (Leptostracan Crustacea).

PLATE VII.

- Fig. 11. Basal region of swimming leg of immature *Limulus polyphemus* (Xiphosuran Merostomata).
 Fig. 12. First gnathopod of *Limulus polyphemus* (Xiphosuran Merostomata).
 Fig. 13. First thoracic limb of the branchiopodan crustacean, *Limnadia lenticularis*, based on figure by Sars.
 Fig. 14. Gnathobase of third gnathopod of *Limulus polyphemus* (Xiphosuran Merostomata).
 Fig. 15. Swimming leg of eurypteridan merostome, *Eusarcus*, based on figure by Clarke and Ruedemann.
 Fig. 16. Base of leg of *Scorpio* sp. (Scorpionidan Arachnida).
 Fig. 17. "Coxa of fourth left endognathite seen from below" of eurypteridan merostome, taken from figure by Clarke and Ruedemann.
 Fig. 18. Fourth thoracic limb of opisthoparian trilobite, *Neolenus*, based on figure by Walcott.
 Fig. 19. Sixth or seventh limb of *Apus* sp. (Branchiopodan Crustacea).
 Fig. 20. First limb of *Apus* sp. (Branchiopodan Crustacea).
 Fig. 21. First thoracic limb of syncaridan crustacean, *Paranaspides lacustris*, from figure by Smith.

PLATE VIII.

- Fig. 22. Mandible of *Apus productus* (Branchiopodan Crustacea).
 Fig. 23. Mandible of *Branchippus vernalis* (Branchiopodan Crustacea).
 Fig. 24. Mandible of *Apus productus*—same as Fig. 22, but in position normally assumed when *in situ*.
 Fig. 25. Mandible of *Conilera cylindracea* (Isopodan Crustacea).
 Fig. 26. Mandible of *Crangon vulgaris* (Decapodan Crustacea).
 Fig. 27. Mandible of male *Gnathia maxillaris* (Isopodan Crustacea).

Fig. 28. Mandible of *Squilla* sp. (Stomatopodan Crustacea).

Fig. 29. Mandible of *Caprella* sp. (Amphipodan Crustacea).

Fig. 30. Mandible of *Calanus* (Copepodan Crustacea), drawn partly from specimen, partly from figure by Borradaile.

Fig. 31. Left (?) "mandible" of *Peripatus* sp., drawn from several sources.

Fig. 32. Distal region of mandible of isopod crustacean, *Cirolana concharum*. The mandibular palpus is cut off.

Fig. 33. Mandible of ostracod crustacean, *Acanthocypris bicuspis*, from figure by Claus.

Fig. 34. Apical region of mandible of ostracod crustacean, *Cypris pubera*, from figure by Claus.

Fig. 35. Mandible of *Leander serratus* (Decapodan Crustacea).

Fig. 36. Body of mandible of *Ligia* sp. (Isopodan Crustacea).

REVISION OF THE GENUS *LIGYROCORIS* STÅL (HEMIPTERA, LYGÆIDÆ).

BY H. G. BARBER.

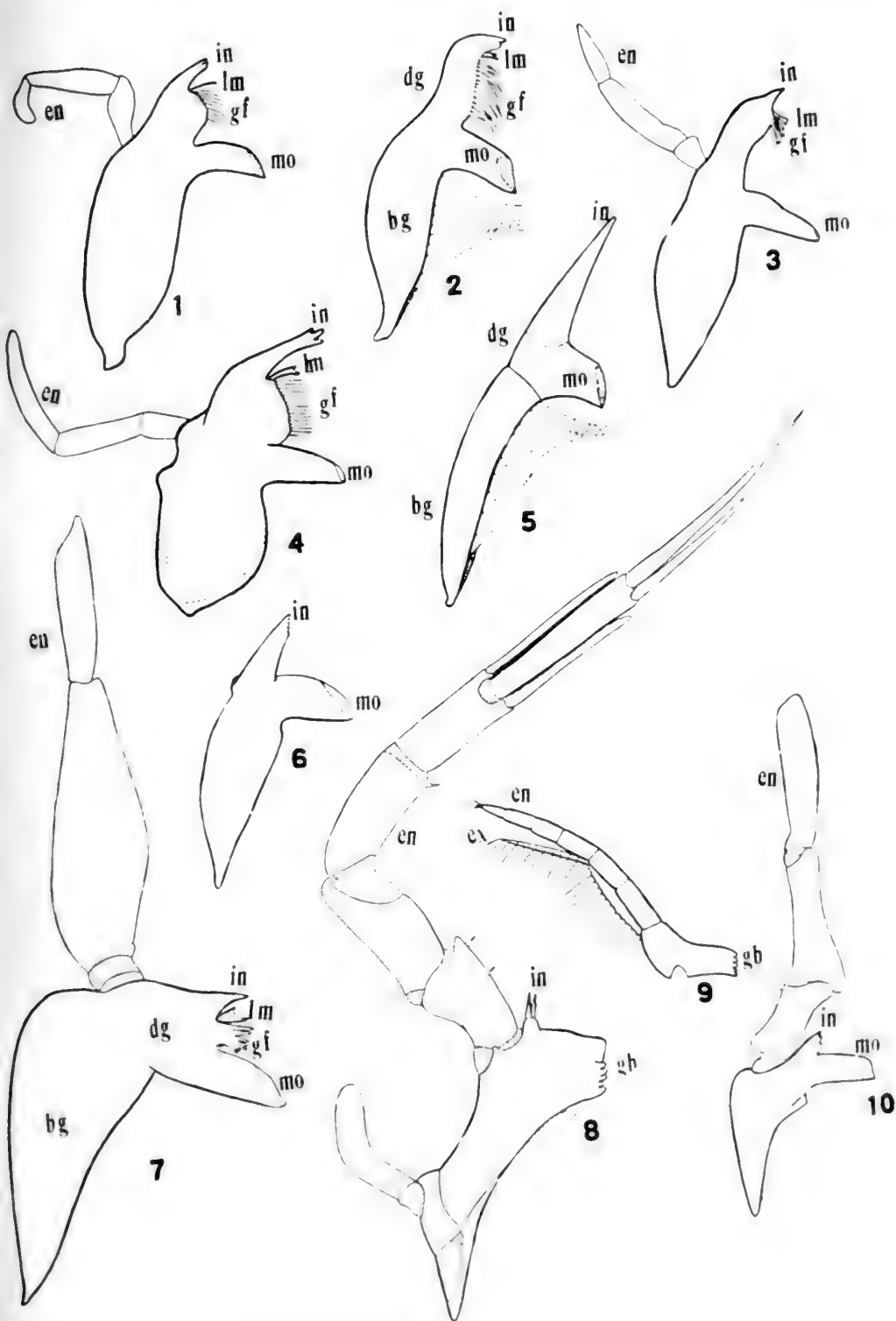
ROSELLE PARK, N. J.

The genus *Ligyrocoris* was founded by Stål in 1872¹ with *Cimex sylvestris* L., Fieb. named as type. The author's short diagnosis translated reads: "Disk of the second and third ventral segments furnished on both sides behind the acetabulæ with a denuded, densely and very delicately strigose vitta; first segment of the posterior tarsus doubly or in exotics more than doubly longer than the two apical segments together; anterior femora armed beneath anteriorly with two or three larger and several very minute spines; third segment of the rostrum much longer than the fourth."

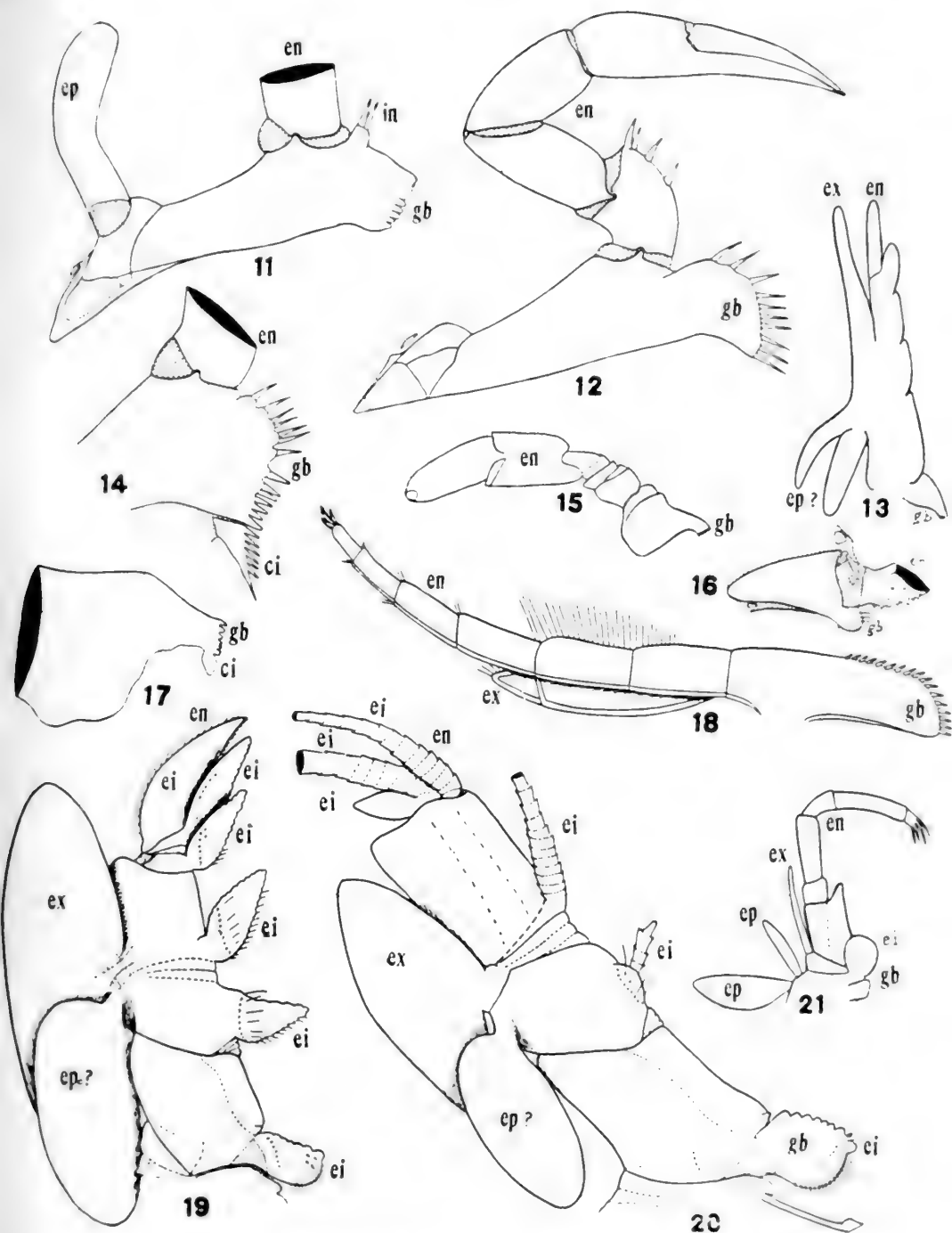
In 1874² Stål in his treatment of the genus as it pertained to America dropped from his diagnostic characters the relative lengths of the third and fourth segments of the rostrum and of the segments of the posterior tarsus. He arranged six species under the genus, as follows: *L. balteatus* and *multispinus* as new species, *Plociomerus sylvestris* Lin., *Plociomera litigiosa* Stål, *Lygæus abdominalis* Guér.

¹ Stål, Of. Vet. Akad. Förh., XXIX, 51, 1872.

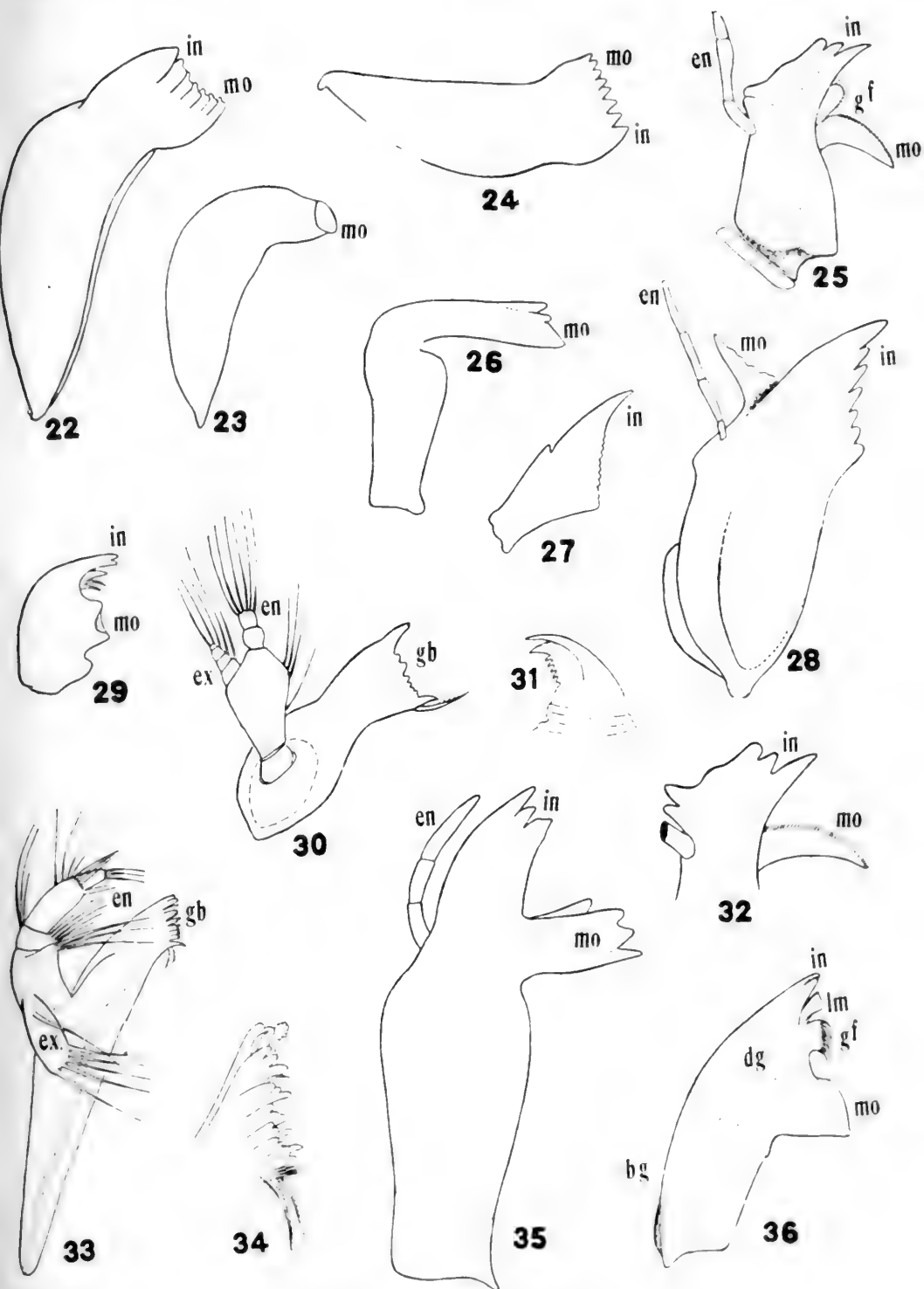
² Stål, Enum. Hem., IV, 144, 145, 1874.



MANDIBLES OF INSECTS.



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and *Pamera constricta* Say, the last named in error. *Plociomerus diffusus* Uhl. and *Pamera contracta* Say were placed as synonyms of *sylvestris* L. which arrangement was accepted by Uhler, until 1908, when Van Duzee³ properly separated *diffusus* as distinct, *L. contracta* is also considered as distinct from the Palearctic *sylvestris* by Van Duzee. As discussed later I cannot concur in this opinion. Since Stål's time the genus has increased somewhat in size by the addition of new species and the transference of others.

The genus *Ligyrocoris* is rather widespread, represented in the Palearctic faunal realm by two species—*sylvestris* in northern Europe and Asia and *terminalis* in Japan, while in the present paper twenty species are shown to occur in the Nearctic-Neotropical realms. While only five species are known from the Northern United States fifteen species are listed from the Upper and Lower Sonoran faunal areas of the United States and Mexico.

KEY TO SPECIES.

1. Head and thorax dull, not shining, most commonly black. Corium with or without post-median fascia. Basal segment of antenna short, much shorter than basal segment of rostrum (subgenus *Ligyrocoris* Stal)...7
- Head and thorax shining, commonly castaneous. Corium with postmedian fascia and preapical pale spot. Basal segment of antenna long, quite or nearly as long as basal segment of rostrum. Males frequently with tibial tooth (*Neoligyrocoris* n. subg., type, *aurivillianus* Dist.).....2
2. Fore tibia of males much curved and armed with a stout median tooth. Terminal segment of antenna with or without pale basal ring.....3
- Fore tibia of males either straight or curved but unarmed with a median tooth. Terminal segment of antenna not pale ringed at base.....5
3. Terminal segment of antenna pale ringed at base. Anterior lobe of pronotum longer than wide and two or three times as long as posterior lobe. Larger species, over 6 mm. long.....4
- Terminal segment of antenna not pale ringed at base. Anterior lobe of pronotum slightly wider than long, short, only a little longer than posterior lobe. Tibial tooth nearer apex than base. Smaller species 4 mm. long (Southwest U. S.).....*nitidicollis* Stål
4. Anterior lobe of pronotum never more than twice as long and plainly narrower than posterior lobe. Interocular space narrow, plainly less than twice the diameter of eye. Apex of membrane with a triangular pale spot. Tibial tooth nearer to base than apex. Narrow elongate (Tex.).
aurivillianus Dist

³ Van Duzee, Canad. Ent., XL, 110, 1908.

- . Anterior lobe of pronotum over twice as long and fully as wide as posterior lobe. Interocular space over twice as wide as diameter of eye. Apex of membrane not triangularly pale. Tibial tooth nearer apex than base. Commonly brachypterous (California).....**sobrius** Uhl.
- 5. Anterior and posterior lobe of pronotum nearly equally long, the former plainly wider than long, sparsely setose. Fore tibia nearly straight. Basal segment of posterior tarsus nearly three times as long as second and third segments together. Hind tibia with fine stiff bristles only (Southwest U. S.).....**rubricatus** n. sp.
- . Anterior lobe of pronotum longer than wide, nearly twice as long as posterior lobe. Fore tibia plainly curved. Basal segment of posterior tarsus scarcely twice as long as second and third segments together...6
- 6. Dorsal parts, antennæ and legs rather densely setose. Hind tibia provided with numerous long setose hairs between the stiff bristles. Membrane almost entirely pale (Colorado)**coloradensis** n. sp.
- . Dorsal parts, antennæ and legs sparsely setose. Hind tibia scarcely setose between the fine bristles. Membrane triangularly pale at apex (Southwest U. S.).....**nitidulus** Uhler.
- 7. Corium outwardly without a postmedian transverse fascia.....8
- . Corium outwardly with a postmedian transverse fascia.....11
- 8. Corium with narrow costal margin pale. Fore femora provided only with an inner series of spines.....9
- . Corium broadly pale without the median vein. Fore femora with an inner and outer apical series of spines. Ventral lunate vittæ sometimes obscured by coating of fine hairs (Pacific Coast)...**latimarginatus** n. sp.
- 9. Ventral lunate vittæ not obscured by coating of fine hairs. Posterior lobe of pronotum commonly wider than anterior lobe. Anteoocular distance to apex of antenniferous tubercles nearly equal to postocular space or the former plainly not twice as long as the latter. Membrane either streaked through the middle or much mottled with pale.....10
- . Ventral lunate vittæ much obscured by coating of fine hairs. Anterior and posterior lobe of pronotum of nearly equal diameter. Anteoocular distance to apex of antenniferous tubercles nearly twice as long as postocular space. Outer basal angle and basal veins of the membrane pale (Eastern U. S.).....**obscurus** n. sp.
- 10. Membrane broadly streaked with pale through the middle. Anterior lobe of pronotum scarcely setose, less transverse and plainly longer than posterior lobe. Second segment of antenna nearly two and one half or three times as long as basal (Eastern states).....**depictus** n. sp.
- . Membrane spotted with pale. Anterior lobe of pronotum sparsely setose, very transverse, exclusive of collar only slightly longer than posterior lobe. Second segment of antenna about twice as long as basal (Southwest U. S.).....**litigiosus** Stål.
- 11. Terminal segment of antenna pale ringed at base.....12
- . Terminal segment of antenna not pale ringed at base.....13

12. Fore femora with only an inner series of spines. Head and pronotum provided with long setose hairs. Second segment of antenna over twice as long as basal segment. Basal segment of posterior tarsus over twice as long as second and third together. Membrane much variegated with pale (Southern U. S.).....**abdominalis** Guer.
- Fore femora with inner series of strong spines and apical outer series of small spines. Head and pronotum with shorter setose hairs. Second segment of antenna about twice as long as basal. Basal segment of posterior tarsus not twice as long as second and third together. Membrane with interior veins pale (Mexico; Florida)....**multispinus** Stål.
13. Eyes not set midway in the head; antecular distance to apex of antenniferous tubercles longer than or subequal to postocular distance. Anterior lobe of pronotum not narrow, much more than half the diameter of the posterior lobe. Basal segment of antenna short, about one half the length of basal segment of rostrum. Head, pronotum and anterior femora sparsely or scarcely setose. Fore femora armed with a few spines towards apex. Membrane not decolorous.....14
- Eyes set about midway in the head, postocular distance a little longer than antecular distance to apex of antenniferous tubercles. Anterior lobe of pronotum very narrow, narrower than diameter of head across eyes, nearly one half the diameter of posterior lobe. Basal segment of antenna more than half as long as the basal segment of rostrum. Head, pronotum and anterior femora rather densely long setose. Fore femora armed with a row of strong spines for nearly its entire length. Membrane nearly decolorous (Southwestern U. S.).....**setosus** Stål.
14. Anterior lobe of pronotum piceous, postmedian transverse fascia always well marked. Fore femora armed on the outer half with two or three strong spines, preceding and following the preapical one with two or three fine small teeth.....15
- Anterior lobe of pronotum not piceous, either grayish or partially infuscated. Fascia of corium sometimes reduced or wanting. Fore femora provided with one or two preapical minute spines sometimes reduced to mere tubercles (Southwest U. S.).....**delitus** Distant.
15. Anterior lobe of pronotum and fore femora nearly or quite devoid of setose hairs. Diameter of pronotum at collar subequal to diameter at constriction between the two lobes. Markings of corium fuscous or piceous with the postmedian fascia extended entirely to the edge of the hemielytra. Membrane most commonly not extended to apex of the abdomen, apex triangularly pale (Northern U. S.)....**sylvestris** Linn.
- Anterior lobe of pronotum and fore femora sparsely setose. Diameter of pronotum at collar plainly less than at constriction between the two lobes. Markings of the corium castaneous or ferrugineous with the postmedian fascia generally not quite reaching edge of hemielytra. Membrane commonly produced to end of abdomen, veins for the most part pale (Northern U. S.).....**diffusus** Uhl.

Ligyrocoris (*Neoligyrocoris*) **nitidicollis** Stål.STÅL. Enum. Hem., IV, 150, 1874 (*Pamera*).BARBER. Bull. A. M. N. H., XXXIII, 514, 1914 (*Ligyrocoris*).VAN DUZEE. Cat. 184, 1917 (*Orthæa*).

This is a small, shining species placed by Stål in the genus *Pamera*. Stål's description of the female only is rather meagre and fails to indicate very common color variations. Though the head, anterior lobe of the pronotum and scutellum as well as the fasciation of the hemielytra may be blackish more commonly these parts with the exception of the scutellum are pale castaneous or ferrugineous; the collar and the posterior lobe of the pronotum pale stramineous, punctate with ferrugineous. The anterior femora and præapical part of second and third femora most frequently are also ferrugineous. Other important characters omitted by Stål are: the head is relatively short, much as in *Heræus*, front much inclined, the eyes so placed that the postocular space is about equal to the space between apex of antenniferous tubercles and eyes; head and pronotum sparsely setose; first three segments of antennæ pale, fourth uniformly darker; membrane slightly embrowned with the apex and some spots toward base pale; fore tibia of males much curved basally and provided with a stout tooth one third the distance from apex; fore femora quite setose and armed almost throughout with a single series of scattered unequal, relatively strong spines, one or two in the middle largest. Length 4 to 4½ mm.

Distribution.—Texas (Stål); Cypress Mills, Tex., Dallas, Tex., Galiuro Mts., Ariz. (Coll. by H. G. Hubbard), "*Ariz.*" (P. R. Uhler Coll.) Coll. of U. S. N. M.; Monterey, N. L., Mexico (Coll. of J. R. de la Torre-Bueno).

Ligyrocoris (*Neoligyrocoris*) **aurivillianus** Distant.

DISTANT. Biol. Cent. Amer. Het., I, 209, Tab. XX. fig. 8. 1882.

(*Pseudopamera pseudoheræus* Barber, Bull. Bklyn. Inst. of A. and S., 275, 1906 (*Ligyrocoris*); JOURN. N. Y. ENT. SOC., XXVI, 45, 1918.

After a careful study of Mexican material in the collection of Mr. Torre-Bueno, I am fully convinced that my *pseudoheræus* is a synonym of Distant's species, as suggested by me in 1918. In the Brownsville, Texas, material I had only females for study and thus was unaware of the character of the fore tibia of the male. Mr.

Van Duzee is certainly in error in remarking that my *pseudoheraeus* may not be distinct from *Heraeus eximius* Dist.

Distribution.—Mexico (Distant); Brownsville and New Braunfels, Texas (Barber); Pt. Isabel and Brownsville, Tex. (H. S. Barber Coll.), Nueces, Tex. (Marlatt Coll.), Tucson, Ariz. (H. G. Hubbard Coll.) and L. California (P. R. Uhler Coll.) all in the Coll. of U. S. N. M.; San Jose, Tamps, Mexico (Coll. of J. R. de la Torre-Bueno).

***Ligyrocoris* (*Neoligyrocoris*) *sobrius* Uhler.**

UHLER. Proc. Calif. Acad. Sci., Ser. 2, IV, 241, 1894 (*Cnemodus*).

The author described this species only from the more common brachypterous form. Because of the peculiar character of the pronotum and his failure to notice the ventral lunate vittæ he placed it in the genus *Cnemodus*. The macropterous form, of which I have seen only a single male specimen, shows more aptly its *Ligyrocoris* affinity. In this form the species has much the color and appearance of *nitidulus* and *coloradensis*. Uhler's description however contains an error which must have been typographical as in the brachypterous form the pale posterior lobe of the pronotum is a little narrower and in the macropterous form about as wide as the black anterior lobe; the former being at least one third as long as the rather globose, elevated anterior lobe. This species belongs to the group in which the much curved anterior tibia of the males have a median tooth. The fore femora are armed with two series of spines in their apical two thirds, the outer series consisting of five widely separated medium stout teeth, the inner series of about the same number of which one shortly before apex is enlarged.

Distribution.—Lower California and California (Uhler); San Diego Co., Calif. (Van Duzee); Los Angeles Co., Calif. (my Coll.).

***Ligyrocoris* (*Neoligyrocoris*) *rubricatus* new species.**

Shining, very sparsely setose. Anterior lobe of pronotum, except collar, and scutellum black; head and collar ferruginous red; antennæ and legs sordid yellow, the femora spotted with fuscous; the posterior lobe of pronotum, the hemielytra anteriorly sordid yellow with the inner field more or less suffused with fuscous and with a broad postmedian fascia and apex dark brown, before apex with an irregular conspicuous white spot; membrane embrowned with its apex broadly pale.

Antennæ rather long, basal segment extended beyond apex of head for less than half its length, second segment one third longer than third, fourth segment only a little shorter than second. Head nearly nude, postocular and anteocular space to apex of antenniferous tubercles nearly equal. Pronotum deeply constricted just behind middle, very sparsely setose, anterior lobe rather globose, a little wider than long, shorter posterior lobe sparsely punctate, sordid yellow, more or less infuscated. The hind femora have a præapical brownish band. The fore tibia are straight and unarmed in the male. The fore femora are armed with two series of spines towards apex at least, the inner series consists of three stronger spines beyond the middle between which are several smaller spines, the outer series near apex consists of two or three minute teeth.

Length 6 mm.

Type: ♂ Safford, Ariz., July 19, 1914 (E. G. Holt collector, U. S. N. M., from Coll. of W. L. McAtee). Following paratypes: ♀ Bear Wallow, St. Catalina Mts., Ariz., July 12-17, 1916, and ♀ Sabino Basin, St. Catalina Mts., Ariz., July 8-20, 1916 (A. M. N. H.); ♀ Palm Springs, Calif., Feb. 25 (U. S. N. M.); ♀ Huachuca Mts., Ariz., Aug. 3, 1905 (my Coll.).

Ligyrocoris (*Neoligyrocoris*) **coloradensis** new species.

Very closely related to *nitidulus* Uhl. and only distinguishable from that species by comparative differences. Coloration and pattern of markings much the same. Head longer, plainly longer than wide, sides of antenniferous tubercles nearly as long as eye; first segment of antenna longer, apex of tylus not reaching the middle point of it. Pronotum with anterior lobe more swollen and over twice as long as posterior one; seen from the side the former is more elevated; collar wider; dorsal surface more densely pilose. Armature of fore femora and character of the tibia much the same as in *nitidulus*. Transverse fascia of corium not so conspicuous, inwardly and posteriorly fused with apical spot, leaving a small inconspicuous pale spot outwardly. Membrane reaching apex of abdomen generally entirely pale or faintly embrowned within. Length $6\frac{1}{2}$ -7 mm.

Described from five ♂♂ and four ♀♀ collected in northern Colorado April 11, 1898, by E. D. Ball. Type and paratype my collection, 6 paratypes in Coll. Prof. E. D. Ball and 1 paratype in Coll. of Prof. Herbert Osborn.

It is very likely that Van Duzee's record of *nitidulus* from Colorado should be placed here.

Ligyrocoris (*Neoligyrocoris*) **nitidulus** Uhler.

UHLER. No. Amer. Fauna, VII, 262, 1893 (*Pamera*).

BANKS. Cat. Hem. 64, 1910 (*Ligyrocoris*).

In his Check List and various papers Uhler recognized the genus *Ligyrocoris* and it therefore seems strange that he failed to recognize

the true affinity of this species in so much as he remarked in the description of it that the venter of the female has a sickle-shaped callosity running backward from the base. The rather strongly curved anterior tibia of the male is unarmed and the teeth of the fore femora are not set in a single row; the outer series consists of a few shorter teeth before apex, the inner series of several irregular larger teeth, the first one about a third away from base between which and apex are about five or six stout teeth, either one or two near the middle usually being the largest of the series and those before apex reduced in size.

Distribution.—Argus Mts., Calif., Texas, New Mexico, and Lower California (Uhler); Colorado [?] and Arizona (Van Duzee); Huachuca Mts., Ariz., Burnet Co., Tex. (my collection); "Tex.", Ft. Grant, Ariz., San Rita Mts., Ariz., Galiuro Mts., Ariz., Bradsh. Mt., Ariz., Chiric Mts., Ariz. (U. S. N. M.).

***Ligyrocoris latimarginatus* new species.**

Dull, very sparsely setose. Head black, sparingly setose, tylus red. Antennæ pale stramineous, apex of second, third and fourth except at base, fuscous, apical third of basal segment extended beyond apex of head, second segment longest of all, third and fourth segments subequal. Rostrum, except at apex, pale stramineous, basal segment a little longer than basal segment of antennæ, its apex nearly reaching base of head. Anterior lobe of pronotum dull black, sparsely setose, very little wider than long, not twice as long as posterior lobe; posterior lobe of pronotum infuscated, with humeral margins and three obscure discal streaks paler, rather finely and not closely punctate. Scutellum black with apex pale. Hemelytra anteriorly and laterally to median vein broadly pale stramineous, punctate with fuscous; clavus posteriorly, inner apical angle broadly and entire apical margin narrowly fuscous. Membrane fuscous variegated with pale spots. Legs pale stramineous, with the fore femora mottled or smudged with brown and the apices of the second and third femora infuscated. Fore femora provided on the outer half with three widely separated larger spines, preceding and following the preapical one are several smaller teeth. Tibia with stiff bristles only. Basal segment of posterior tarsus very long, three times as long as second and third segments together. Sternum and venter black, acetabule and posterior margin of metasternum pale.

Length, ♂ 7 mm.; ♀ 8 mm.

Type, ♂, and allotype, Alameda Co., Calif., Sept. 20, 1906, coll. by Chas. Fuchs; paratypes: 2 ♂♂ "Calif.," ♂ "W. T.," ♂ Umatilla, Oregon, June 24, 1882, 2 ♀♀ Sta. Monica, Calif., June 6, 1901 (Coll. U. S. Nat. Mus.). ♀ Mt. Shasta, Calif. (my coll. from C. E. Olsen).

This species is readily distinguished by the entire absence of the post-median fascia of the corium. Occasionally the ventral lunate vittæ are somewhat obscured by the dense coating of fine hairs. It should be placed close to *litigiosus*.

Ligyrocoris obscurus new species.

Form rather narrow elongate, dull, sparsely setose; very closely resembling *Zeridoneus* (*Perigenes*) *costalis* Van Duzee. Head black, sparsely long setose, with coating of fine impressed golden yellow hairs; apex of tylus reddish. Antennæ long, stramineous, extreme base of first, apex of second lightly, apical half of third and all of fourth segment, fuscous; apical half of basal segment extending beyond apex of head, second segment two and one half times as long as first, third about one third shorter than second and subequal to terminal segment. Pronotum dull black, sparsely setose, with the transverse constriction shallowly, obtusely impressed, anterior lobe a little wider than long; posterior lobe little wider and except for humeral angles scarcely paler than anterior lobe, rather closely and finely punctate; lateral margin from the humeral angles stramineous. Scutellum black, apex pale, posteriorly keeled, closely punctate along the sides. Hemelytra infuscated, entire costal margin, a streak outside of claval suture opposite apex of scutellum and a spot near inner apical angle, stramineous-yellow. Membrane fuscous with some of the veins basally and a few scattered spots, pale. Beneath piceous, the venter densely coated with fine golden lunate vittæ. Legs stramineous-yellow, fore femora from about middle towards apex, hind femora apically, intermediate femora more faintly and apices of all tibiæ infuscated. Fore femora armed on the outer half with two series of spines, the inner series consists of three larger spines, the first two just beyond the middle are set closer together, and the third midway to apex, before and beyond the latter are some three or four very small teeth; the outer series consists of three or four minute teeth towards apex. The hind tibia are provided with some 11 bristles in each side and the basal segment of the hind tarsus is a little over twice as long as second and third together.

Length, ♂ $7\frac{1}{2}$ mm.; ♀ $8\frac{1}{2}$ mm.

Type: ♂ Plummers Is., Md., Feb. 8, 1905, collected by D. H. Clemons (U. S. N. M.). Paratypes: 2 ♂♂ and 2 ♀♀ Plummers Is., Md.; ♀ Cabin John, Md., Feb. 9, 1914; ♀ Ogle Co., Ill. (U. S. N. M.); 2 ♂♂ Plummers Is., Md. (from O. Heidemann); ♂ Kansas; ♀ Cabin John Run, Md., Sept. 23, 1911, collected by Wm. T. Davis (my collection); ♂ Plummers Is., Md., Sept. 21; ♀ Cabin John, Md., Sept. 2, 1907; ♀ Glen Echo, Md., Oct. 12, 1901, from the collection of Mr. O. Heidemann (Cornell Univ.).

Very similar in appearance to *Zeridoneus* (*Perigenes*) *costalis* Van Duzee which species shows no trace of the lunate strigose vittæ. Furthermore in *L. costalis* the antennæ are shorter with the first

segment fuscous and apical third extended beyond apex of head, the posterior lobe of the pronotum is not so closely punctate and is marked with two or three median longitudinal paler streaks; the hind tibiae are less bristly and the hind tarsus with basal segment relatively longer, nearly three times as long as second and third segments together. Specimens labeled *Lig. costalis* in the collection of Mr. Heidemann explains why this was recorded by Banks as belonging to this genus.

***Ligyrocoris depictus* new species.**

Very similar to and very closely related to *L. diffusus* Uhl. Coloration of body parts, antennae and legs the same. The hemelytra, however, are almost entirely dark castaneous brown within; the base, entire costal margin and much reduced inner apical spot stramineous-yellow, with no traces of transverse postmedian costal fascia. The membrane is brown with a longitudinal median streak and some of the veins basally pale.

The antennae are unusually long, with all of the segments except the basal one relatively longer than in *diffusus*. The pronotum is differently shaped and devoid of setae; constricted well behind the middle, leaving the dull black anterior lobe nearly twice as long and scarcely narrower than the posterior lobe; the width in front is subequal to the diameter at the constriction. The number and arrangement of the spines on the fore femora is not distinctive. Most frequently the membrane does not reach the apex of the abdomen, in other cases it is fully developed.

Length 5-6 mm.

Described from 15 ♂♂ and 11 ♀♀. Type, ♂, Ramsey, N. J., June 23, 1912 (coll. by Dr. C. L. Pollard), in my collection. Paratypes: ♂, Ramsey, N. J., June 23, 1912; ♀ Bear Swamp, Ramapo Mts., N. J., July 25, 1911; ♀ Greenwood Lake, N. J., June 14; ♀ Wood's Hole, Mass., July 21, 1868; ♂♀ White Plains, N. Y., June 27, 1909 (coll. by T. R. de la Torre-Bueno), in my collection.

♀ Glen Ridge, N. J., July 4, 1906, 12 ♂♂ and 4 ♀♀ White Plains, June and July (coll. of J. R. de la Torre-Bueno); ♀ White Plains, N. Y., July (coll. of E. P. Van Duzee); ♀ Ithaca, N. Y., Aug. 7, 1889 (coll. Cornell Univ.); Portland, Conn., Aug. 9, 1913 (coll. Conn. Exp. Sta.).

***Ligyrocoris litigiosus* Stål.**

Stål. Stett. Ent. Zeit., Vol. 23, 313, 1862 (*Plociomera*).

Stål. Enum. Hemipt., IV, 145, 1874 (*Ligyrocoris*).

This species is not so closely related to *abdominalis* as it is to *diffusus*, being the same general size and shape but quite differently colored and marked. The corium has the costal margin pale, in-

wardly the surface suffused and punctate with fuscous rather than ferrugineous, generally with slight trace if any, of the postmedian transverse fascia; the apex frequently slightly infuscated. The membrane is pale brown much variegated with pale. The femora are either entirely stramineous or at least towards apex spotted with fuscous. The dorsal anterior parts not as setose as in *diffusus*. Number and arrangement of spines and teeth of anterior femora much as in that species.

Described by Stål from Mexico, since recorded by Van Duzee from Florida and in my collection are four specimens from the Huachuca Mts., Ariz., collected by me in 1905. In the U. S. N. M. are several specimens from Mexico and one from Lower California. Distant records it from Guatemala and Colombia, S. A.

***Ligyrocoris abdominalis* Guérin.**

GUÉRIN. La Sagra's Hist. de Cuba, VII, Ins., 165, 1857 (*Beosus*).

STÅL. Enum. Hem., IV, 146, 1874 (*Ligyrocoris*).

DISTANT. Biol. Cent.-Amer. Rhynch. Het., I, 202, Plt XVII, fig. 21, 1882.

piliger Stål—Stett., Ent. Zeit., XXIII, 312, 1862 (*Plociomera*).

constrictus Say—Uhler, Bull. U. S. G. and G. Survey, II, 309, 1876;

Proc. Boston Soc. N. H., 388, 1878; Check List. Hem., 14, 1886.

This species has frequently been confused with what has been for so many years catalogued as *Ligyrocoris constrictus* Say but that species is now placed in the genus *Perigenes* Distant as it lacks the lunate vittæ on the anterior ventral segments of the abdomen.

Originally described from Cuba, it is the largest and one of the most widely spread members of the genus. The head, anterior lobe of pronotum, scutellum and beneath dull piceous black, the posterior lobe of the pronotum usually has three pale fascia in the middle and the humeral angles pale. The hemielytra are pale stramineous yellow, punctate with fuscous, just behind middle broadly fasciate and at apex fuscous. Membrane fuscous variegated with pale, at least along the sides. Antennæ usually have the basal segment, tip of the second and third and more than apical half of the fourth segment ferruginous or fuscous, the pale basal ring of the fourth segment is quite conspicuous. The legs are variable but generally the fore femora except extreme base and apex and a præapical ring on the intermediate and posterior ones, black. The dorsal parts, venter and femora, provided with a sparse covering of long setose hairs. Fore

femora armed with a single inner series, consisting of two larger spines, the first one a little before middle, the other a little before apex, between these are three or four even minute teeth, and before the præapical spine two small spines. Length 7-8 mm.

Distribution.—Warmer parts of the United States, Florida, Louisiana and Texas; Mexico, Central America and the West Indies.

***Ligyrocoris multispinus* Stål.**

STÅL. Enum. Hem., IV, 145, 1874.

DISTANT. Biol. Cent.-Am., Het., I, 201, Pl. 17, fig. 18, 1882.

BERG. Nova Hemipt., 74, 1892.

VAN DUZEE. Bull. Buff. Soc. Nat. Hist., IX, 171, 1909.

confraternus Barber. Bull. A. M. N. H., XXIII, 512, 1914.

Van Duzee has placed this species close to *abdominalis* where it properly belongs. It was largely because of Stål's placing this close to his *sylvestris* and Distant's incorrect figure of the type which led to my error in redescribing it from Florida as *confraternus*. It is slightly shorter and narrower than *abdominalis*, varying from fuscous to ferrugineous in color and is also sparingly setose. The fourth segment of the antenna is annulate with pale at base. The femora though variable are not black but dirty yellow ferrugineous spotted with ferrugineous. The fore femora have a double series of spines as described by Stål and myself for *confraternus*. I have seen no specimen quite as large as indicated by Stål.

Distribution.—Florida, Mexico, Central America, Brazil, Venezuela and probably all of northern South America.

***Ligyrocoris setosus* Stål.**

STÅL. Enum. Hem., IV, 150, 1874 (*Pamera*).

BARBER. Bull. Am. Mus. Nat. Hist., XXXIII, 514, 1914 (*Ligyrocoris* = *Herans percultus* Dist.).

VAN DUZEE. Cat. Hem., 180, 1917; *loc. cit.*, 185 (*Ortheca*).

percultus Distant. Biol. Cent.-Am., I, 205, Pl. 19, fig. 10, 1882 (*Herans*).

VAN DUZEE. Trans. San Diego Soc. Nat. Hist., II, 9, 1914 (*Ligyrocoris*).

Placed by Stål in the genus *Pamera* just before *nitidicollis* and Distant failing to recognize the species and because of the character of the head redescribed it from Guatemalan material as *Herans percultus*. The species is fairly well characterized by the author

The head as seen dorsally and laterally is very much the same as in *nitidicollis* but the post-ocular space is, if anything, a little longer than the ante-ocular space to apex of antenniferous tubercles. The fore femora are profusely long setose and provided for three fourths their length with numerous strong teeth set in two irregular series, at least apically.

Distribution.—Texas (Stål); Guatemala (Dist.); Huachuca Mts., Ariz. (my coll.); "Ariz.," "Tex.," San Diego, Tex., Palm Springs, Calif. (U. S. N. M.), San Diego Co., Calif. (Van Duzee).

***Ligyrocoris delitus* Distant.**

DISTANT. Biol. Cent.-Amer. Het., I, 201, Tab. XVIII, fig. 20, 1882.

This is a small species about 4 mm. long, of which Distant gives a very good description and figure. It is closely related to *litigiosus* and Distant remarks it is allied to *balteatus* but this latter species I have not been able to recognize. Considerable variation occurs in the color and extent of markings. The head and anterior lobe of pronotum and scutellum varying to pale ferrugineous. The post-median transverse fuscous fascia of the corium is frequently not extended to the margin but confined to the inner area. The head and pronotum are quite pilose. The fore femora are armed with three small preapical teeth.

Distribution.—Guatemala (Distant); San Jose, Tamps, Mex. (Coll. by J. R. de la Torre-Bueno); Huachuca Mts., Ariz.—seven specimens collected by me in 1905; San Diego Co., Calif. (coll. of E. P. Van Duzee).

***Ligyrocoris sylvestris* Linn.**

LINNÆUS. Syst. Nat., Ed. X, 449, 1758; Faun. Suec., 256, 1761 (*Cimex*).

FALLEN. Hem. Suec. Cim., 61, 1829 (*Lygæus*).

FIEBER. Europ. Hem., 171, 1861 (*Plociomerus*).

UHLER. Check List, 14, 1886 (exc. *diffusus* Uhl. from syn.).

HORVATH. Ann. Hist.-Nat. Mus. Nat. Hung., VI, 5, 1908.

OSHANIN. Verzeich. d. Palæarkt. Hem., I, 308, 1906–1909 (*Ligyrocoris*).

Contractus Say, New Harm. Ind., 1831; Complete Writ. (Lec. Edit.), 332, 1859 (*Pamera*) Stål—Enum. Hem., IV, 145, 1874 (*Ligyrocoris sylvestris* Stål—var. b *contractus* Say, Leth. et Sev. Gen. Cat., 190, 1894; Banks Cat. 64, 1910; Van Duzee Cat. 180, 1917. *Luchsi* Baer., Berl. Ent. Zeit., 330, t. 6, fig. 2, 1859 (*Plociomerus*).

After careful comparison of European specimens of *sylvestris* and United States specimens of *contractus* Say, I am forced to the conclusion that Uhler and Horvath were correct in following Stål in the arrangement of these names. Moreover *sylvestris* is very closely related to and sometimes difficult to distinguish from *diffusus* Uhl. as shown by the fact that Stål placed these together and Uhler accepted this arrangement.

Specimens of *sylvestris* are generally darker colored, with the head, anterior lobe of the pronotum, scutellum and most of the corium behind middle piceous-black; the broad transverse fascia behind middle, rather clean cut and strongly contrasting with the pale anterior surface, extends to the costal margin. Pronotum at the transverse constriction subequal to diameter of anterior margin; width across humeri usually but very little wider than anterior lobe across middle. Whole anterior part, particularly the pronotum, scarcely at all setose. The legs though variably colored, are more inclined to have the fore femora, except apex and base, and the apical part of second and third, piceous or dark brown. Membrane rarely reaching the tip of abdomen, with some of the veins pale and apex conspicuously marked with a triangular white spot.

Distribution.—Over a large part of Europe and Asia, particularly in the northern part. Also in the United States it is more common in Canada and the northern states. Uncommon in New Jersey.

***Ligyrocoris diffusus* Uhler.**

UHLER. Proc. Bost. Soc. N. H., 101, 1871 (*Plociomerus*).

VAN DUZEE. Cat. 180-181, 1917 (for synonymy and literature).

As previously remarked this species is so closely related to *sylvestris* Linn. (= *contractus* Say) that it has led to considerable confusion in synonymy.

Some of the more important differences between the two species may be pointed out. In *diffusus* the darker color markings of the corium tend toward ferrugineous, with contrasting pale colors less striking, as anteriorly the general surface is largely suffused with ferrugineous; the post-median transverse fascia is therefore less clean cut and conspicuous and does not extend quite to the lateral margin. The diameter of the pronotum at the transverse stricture plainly wider than at anterior margin and the width across humeri quite

evidently wider than across middle of anterior lobe. The anterior parts, particularly the pronotum, much more obviously long setose. The legs are pale ferrugineous, sometimes the posterior femora, more rarely the others, are embrowned towards their apices. Membrane usually reaches the apex of abdomen, pale brown with rather conspicuous pale veins and small apical spot. The anterior femora are armed as in *sylvestris*.

Distribution.—From Canada south at least to North Carolina and west across the country to California.

***Ligyrocoris slossoni* Barber.**

BARBER. Bull. Am. Mus. Nat. Hist., XXXIII, 513, 1914.

Described from a single male specimen from Lake Worth, Fla., contained in the collection of Mrs. Slosson. Had it not been for the purpose of giving as complete as possible knowledge of the hemipterous fauna of Florida this species would not have been established upon a unique specimen. Eventually this may prove to be another illustration of the danger of violation of the well advised rule. Later and more thorough study of the specimen, in preparation of this paper, has forced me to the conclusion that it is imperfect. The reddish coloration of head and pronotum may be due to its immaturity. Furthermore the description is in error as to the head. It having apparently become detached has been imperfectly glued into position, leaving the post-ocular space to appear longer than it naturally should. As a matter of fact the post-ocular and ante-ocular dimensions are not unlike those of *L. sylvestris*. Its affinity to this species is closer than to *L. nitidicollis* where I originally placed it because of the mistaken character of the head. For the present at least this will have to remain a doubtful species. I have therefore omitted it from the key to the species.

***Ligyrocoris halteatus* Stål.**

I am obliged to omit this from the synopsis for as yet I have been unable to recognize this species, originally described from Mexico.

NEW SPECIES OF REARED GALL MIDGES (ITONIDIDÆ).

By E. P. FELT, STATE ENTOMOLOGIST.

ALBANY, N. Y.

The following descriptions are of species which have been reared by various correspondents and submitted for identification.

Rhopalomyia sabinæ new species.

Exuvium. Mesonotum, head, leg and wing cases infuscated. The remainder mostly whitish.

Pupa. Length 3 mm., rather stout, the antennal, wing and leg cases brownish. Mesonotum somewhat darker, the abdomen yellowish orange with reddish tints.

Male. Length 3 mm. Antennæ extending to the fourth abdominal segment, sparsely haired, fuscous yellowish, 17 segments, the 5th with a stem about one third the length of the cylindrical basal enlargement, which latter has a length about $2\frac{1}{2}$ times its diameter. Palpi, first segment short, irregular, the second shorter, broadly ovate. Mesonotum dark reddish brown, scutellum fuscous yellowish. Postscutellum yellowish, abdomen sparsely haired, mostly dark brown. Genitalia yellowish orange. Halteres fuscous basally, reddish orange distally, coxæ fuscous yellowish, femora, tibiæ and tarsi mostly pale yellowish. Claws rather long, slender, the pulvilli distinctly longer than the claws. Genitalia; basal clasp segment short, terminal clasp segment moderately long, curved, dorsal plate deeply and triangularly emarginate, the lobes broadly rounded, ventral plate long, broad and broadly rounded.

Female. Length 3.5 mm. Antennæ extending to the base of the abdomen, sparsely haired, pale yellowish, 17 sessile segments, the fifth with a length over twice its diameter. Mesonotum fuscous yellowish, the submedian lines sparsely black haired. Scutellum yellowish, reddish apically, sparsely black haired. Postscutellum yellowish orange. Abdomen mostly deep red, the sclerites dark brown, the basal and distal segments yellowish. Halteres dark reddish. Femora a variable fuscous yellowish or fuscous. Tibiæ and tarsi black. Ovipositor short, the terminal lobes broadly and roundly triangular and thickly clothed with short setæ. Type Cecid. A. 2521.

The species described above closely approaches in general appearance *Walshomyia juniperina* Felt, from which it may be readily distinguished by the biarticulate palpi and marked differences in the structure of the genitalia.

This insect occurs in a purplish, somewhat conical, thick walled, apical bud gall with a length of about 1 cm. and a diameter of 3 mm. When mature the tip splits, forming four or more irregular lobes, the adult escaping from the apex. This gall develops later than that of *Walshomyia texana* according to J. T. Patterson of the University of Texas. This species has been reared from *Juniperus monospermum* from galls collected near Denver, Colo., in 1914, by Professor E. Bethel and from similar galls on *Juniperus utahensis* collected by Professor Bethel at Gilluly, Utah, and also from apparently identical galls on *Sabina sabinoides* collected by J. T. Patterson in April, 1919, near Austin, Texas. The gall has been figured by Mr. Patterson on page 345 of the November, 1919, issue of the Journal of Heredity, volume 10.

Rhopalomyia weldi new species.

Gall. Dark purplish, fusiform, frequently clustered bud galls with a length about 1 cm. and a diameter of .5 cm. Clusters of six or seven are not unusual though occasionally only three or four, or one or two may develop upon a shoot. One small shoot bore eleven galls.

Larva. No larva were found though Mr. Weld stated that they were orange colored.

Pupa. Length 4 mm. Antennal cases fuscous yellowish, eye, wing and leg cases black, mesonotum yellowish orange, abdomen reddish orange with rather thick fuscous hairs on the dorsal sclerites.

Male. Length 4 mm. Antennæ nearly as long as the body, sparsely haired, 18 segments, the fifth with a stem three fourths the length of the basal enlargement, which latter has a length one and three fourths times its diameter. Terminal segment with a narrowly fusiform, pseudo-articulate apex as long as the basal enlargement, the latter with a length nearly three times its diameter. Palpus consisting of one small, narrowly oval segment. Mesonotum shining dark brown. Scutellum and postscutellum dark brown. Abdomen fuscous yellowish. Genitalia fuscous. Halteres fuscous apically, yellowish basally, legs a nearly uniform fuscous straw. Claws long, slender, rather strongly curved apically, the pulvilli nearly as long as the claws. Genitalia, basal clasp segment long, stout, terminal clasp segment short, stout, subfusiform; dorsal plate deeply and triangularly emarginate, the lobes obliquely truncate, ventral plate broad, broadly rounded apically.

Female. Length 3 mm. Antennæ about three fourths the length of the body, sparsely haired, fuscous yellowish, 18 or 19 sessile segments, the fifth with a length $2\frac{1}{2}$ times its diameter, the terminal segment produced, with a length over three times its diameter. Mesonotum shining dark brown. Scutellum and postscutellum a little darker, abdomen deep red, sparsely clothed

with fuscous hairs. Ovipositor yellowish orange. Halteres yellowish basally, fuscous subapically, pale orange apically. Coxæ mostly dark brown, the legs a somewhat variable fuscous straw. Ovipositor as long as the abdomen, the terminal lobes rather slender, with a length four times the width and sparsely setose. Type C. a 2985.

The species described above falls in our key next to *R. bulbula* Felt and *R. lateriflora* Felt, from both of which it is distinguished by habits, colorational characters and variations in antennal and genital structure. The galls were collected by Mr. L. H. Weld at Glencoe, Ill., May 12, 1919, a few midges emerging on their reception May 15. The galls occur on the subterranean stems or root stalks of *Aster macrophyllus*, pushing up through the dead leaves in the spring and when numerous preventing the development of the foliage. This species appears to be somewhat badly parasitized, the parasites forming a series of cocoons, usually consisting of two or three bundles adherent at the ends; one mass contained as many as fifteen, though the average number is usually less.

Walshomyia insignis new species.

Gall. This is a somewhat yellowish leaf tip, hardly distinguishable from the normal. The female escapes near the apex.

Exuvium. Length 1.5 mm. Whitish with a distinct fuscous shade on the wings, thorax and antennal cases.

Female. Length 1.75 mm. Antennæ extending to the second abdominal segment, sparsely haired, reddish brown, the basal segments lighter, 14 sessile segments, the fifth with a length $2\frac{1}{4}$ times its diameter and with moderately high circumfila at the basal third and subapically and on the distal $\frac{2}{3}$, a series of six or seven anastomosing transverse ridges, apparently chitinous and independent of the circumfila; the terminal segments consisting of two closely fused, the apex obtuse. Palpus consisting of one short, irregular, coarsely setose segment. Mesonotum reddish brown, scutellum dark reddish, postscutellum orange reddish, abdomen sparsely haired, mostly deep red, the seventh and eighth segments with a yellowish cast. Halteres fuscous orange, fuscous subapically. Coxæ fuscous yellowish, the legs mostly a fuscous straw. Claws moderately slender, strongly curved, the pulvilli about twice the length of the claws. Ovipositor short, stout, striate, the terminal lobes roundly oval and thickly clothed with short, stout setæ. Type A 2962.

The peculiar female characterized above and tentatively referred to this genus, was reared from an oval, apical bud gall on cedar, collected by Mr. J. M. Del Curto, Austin, Texas, March 26, 1919, and

identified by Doctor H. D. House, State Botanist, as *Juniperus scopulorum*. The adult issued March 31, and is noteworthy because of the numerous peculiar transverse elevations on the antennal segments, suggesting circumfila, though in reality probably transverse chitinous ridges.

Winnertzia fungicola new species.

Male. Length 1.5 mm. Antennæ a little shorter than the body, sparsely haired, dark brown, 14 segments, the 5th with a stem $\frac{3}{4}$ the length of the basal enlargement, which latter has a length $\frac{1}{2}$ greater than its diameter. Terminal segment produced, narrowly conical, with a length fully four times its diameter. Palpi; first segment with a length over twice its diameter, the second nearly twice as long, the third about as long as the second and the fourth nearly one half longer than the third. Entire body a nearly uniform bronzy dark brown. Halteres fuscous yellowish, lighter basally, coxæ mostly dark brown, the legs a variable straw color except for the dark brown of the anterior tarsi. Claws moderately long, stout, strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment moderately long, stout, terminal clasp segment with a length over twice its diameter, distinctly dentate apically, dorsal plate broadly and slightly emarginate, ventral plate divided, the lobes broadly and irregularly rounded.

Female. Length 2 mm. Antennæ extending to the second abdominal segment, sparsely haired, dark brown, 14 sessile segments, the 5th with a length twice its diameter, the terminal segment somewhat produced, with a length fully $2\frac{1}{2}$ times its diameter, the distal third tapering strongly. Mesonotum sparsely haired, purplish dark brown. Scutellum yellowish brown, postscutellum dark purplish brown, abdomen dark brown, with a yellowish cast. Halteres fuscous yellowish, coxæ dark brown, legs mostly dark straw. Ovipositor moderately long, stout, the triarticulate terminal lobes attached to a quadrate basal portion, apparently the terminal segment of the ovipositor. Basal segment of the terminal lobe subquadrate, with a length $\frac{3}{4}$ its diameter, the second irregularly oval with a length $\frac{1}{2}$ greater than its diameter, the third narrowly oval and with a length nearly three times its diameter. Type Cecid. 1797, 1798.

The midges described above were reared by H. B. Weiss, March 31, from a fungus, *Lenzites sapiaria*, collected at Plainfield, N. J., and submitted for identification by Professor C. W. Johnson of Boston, Mass. The male is closely related to *W. rubida* Felt, though this species is distinctly larger, stouter and more heavily chitinated, and presents some differences in antennal and genitalic structures in particular.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF NOVEMBER 2.

A regular meeting of the New York Entomological Society was held November 2, 1920, in the Public Museum, Staten Island, at 8:00 P.M., President L. B. Woodruff in the chair, with nine members and three visitors present.

Noah Levine, 1131 West Farms Road, Bronx, was elected a member of the Society.

The request of Dr. Walther Horn, Berlin, for the replacement of certain missing numbers of the JOURNAL was granted.

Mr. Burns exhibited his collection of "Staten Island Diptera," contained in 11 boxes, the work of the last three years, pointing out some of the more interesting species and the additions to local fauna.

Dr. Bequaert commended the collection for its excellent preparation and arrangement and said it was a remarkable example of what could be accomplished in a short time. He congratulated the collector, who well deserved the compliment paid him by Van Duzee in Buffalo, whereby *Dolichopus burnsii* n. sp. has been named for him. This little fly had been found near Cameron's Pond, Arrochar, Staten Island, while collecting aquarium material for the Museum.

Mr. Davis presented "An Annotated List of Colorado Cicadas" illustrated by his collection thereof and compared with examples of those of New York State. His paper will be printed in the JOURNAL.

Mr. Engelhardt spoke of visits to Tottenville, Staten Island, with Mr. Davis, who in August had discovered a single specimen of *Sesia rileyana*, a northernmost record for the species which occurs from the District of Columbia southward and westward to the Mississippi. Many additional specimens of the moth were found August 24, and in October its larva was found, boring in the roots of *Solanum carolinense*. On the same plant the potato weevil, *Trichobaris trinitata*, was found, while splitting the stems for *Sesia* larvae.

Mr. J. E. Logan, present as a visitor, exhibited a living specimen of *Mantis sinensis*, found at Arlington, Staten Island, on October 20, near 220 South Ave., and said that he had a colony of this introduced species under observation since July 31. He showed dried specimens found on that date. He had known of the existence of the colony since 1916.

Mr. Davis said the matter was of special interest to him because he had put out an egg mass at Arlington in 1913. Mr. Davis also recorded a Staten Island bee tree, found in October near Great Kills, in the top of a hollow oak, blown down by a storm.

MEETING OF NOVEMBER 20.

A regular meeting of the New York Entomological Society was held at 8:00 P.M., on November 16, 1920, in the American Museum of Natural History, President L. B. Woodruff in the chair, with eighteen members present.

Mr. Jones exhibited "A New *Papaipema* and Two Rare Psychids from Southern Delaware." After speaking of the neglect by entomologists of the peninsula formed by southern Delaware, eastern Maryland and eastern Virginia, Mr. Jones described the *Papaipema* he had reared from stems of *Aralia spinosa*, the Hercules Club; and then spoke of the species of Psychidæ, including the large number of references to the well known Bag worm and the scanty information about the other species, ending with an account of a new species discovered on pine.

Mr. Bird called attention to an article in The American Botanist, 1920, Vol. 26, p. 106, on "Mountain Climbing Lady Bugs," which drew forth a reminder of E. K. Carnes' account "Collecting Lady Bugs by the Ton," in the monthly Bulletin of the California State Commission of Horticulture for February, 1912, and a comparison of the habits of Atlantic and Pacific Coast Coccinellidæ.

Mr. Schaeffer gave a learned discussion of the synonymy of the genus *Donacia*, particularly devoted to the recognition, as far as possible without access to types, of the species described by Lacordaire and other early authors. His conclusions required sinking some of the names he had himself proposed in synonymy and in restoring many old names, erroneously placed in synonymy by Dr. LeConte and Leng; but Mr. Schaeffer admitted being still in doubt as to some of the names.

Mr. Engelhardt gave an interesting account of Grape Vine Rootborers, *Paranthrene polistiformis* Harris, of which *P. seminole* Newmoegen is a synonym, known from Vermont to Florida and west to Minnesota, and of two new species, one from Nevada Co., Calif., the other from Victoria, Texas, where it lives in *Ampelopsis incisa*, attacking shoots above ground, causing an enlargement, which the larva leaves to pupate in the ground. A general discussion on mimicry followed.

MEETING OF DECEMBER 7.

A regular meeting of the New York Entomological Society was held at 8:00 P.M., in the American Museum of Natural History, President L. B. Woodruff in the chair, with fifteen members and one visitor present.

The minutes of the preceding meeting were read and approved.

Mr. Albert Effingham Lawrence, 105 West 69th St., was nominated for active membership by Mr. Davis.

Mr. Weiss exhibited the fungus *Fomes applanatus* with the egg capsules of the beetle, *Boletotherus bifurcus*, covered by excrement, deposited in crevices.

Mr. Weiss also reported that an appropriation of \$112,000 had been made by the Legislature of New Jersey to combat the Gypsy Moth near Somerville, permitting the employment of eighty Federal Scouts to destroy egg masses. This work will be followed by spraying in the spring.

Mr. Weiss also showed the mines, pupal cases, larvæ and adults of a new species of *Coptodisca* on Sheep Laurel, which will be named by Dr. Dietz, and over-wintering cases, larvæ and adult of the Apple Leaf Crumpler, *Mimola indiginella*, which he had found on *Cotoneaster microphylla*.

Mr. Bird presented a paper, illustrated by specimens, entitled "Will the European Apple Leaf Skeletonizer, *Hemerochloa pariana*, prove a serious pest?" which was discussed by Dr. Felt and Mr. Weiss. Dr. Felt told of its first appearance in Westchester Co., in 1917, and of the lack of danger in commercial orchards where regular spraying operations take care of it; Mr. Weiss referred to its work on Thorn in nurseries, and both spoke of the characteristic damage to the leaves.

The vice-president having taken the chair, Mr. Woodruff read "Notes on Species of *Ophiderma* (Membracidæ)," confirming his previous publication by additional material, which was exhibited. Mr. Woodruff also spoke of the finding of many living Lathridiidae in boxes of mouldy beetles in his house in New York City, and distributed specimens of *Adistemia watsoni*, found in that way, 100 at a time. The other species found in smaller numbers were *Cartodere elegans* and *costulata* and *Corticaria fulva*. In removing the mould Mr. Woodruff said he had used a 10 per cent. solution of carbolic acid applied with a camel's hair brush.

Dr. Bequaert exhibited "A Curious Case of Mimicry between a Digger Wasp (*Sphex egregia* subsp. *promontorii* Kohl.) and a Fly (*Systropus macilentus* Wild.) in the Congo Region," accentuated in life by the similarity in their behavior. He referred to the excellent work of Dr. Arnold Jacobi "Mimikry und verwandte Erscheinungen." Many members joined in the discussion.

The president appointed as a nominating committee Dr. Bequaert, Mr. Mutchler, Mr. Nicolay.

Dr. Felt spoke of the work of Miss Mabel Colcord in continuing the index to bibliography of Economic Entomology, and of the extraordinary number of references found, which necessitated some elimination and showed incidentally the varying importance of the species involved.

A CORRECTION—The order of Plates I and II of Vol. XXIX should be reversed.—Ed.

Organized June 29, 1892.—Incorporated June 7, 1893.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

WILLIAM T. DAVIS.

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Publication Committee.

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JOURNAL

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New York Entomological Society.

VOL. XXIX. SEPTEMBER-DECEMBER, 1921. NOS. 3 AND 4.

NOTES ON MILKWEED INSECTS IN NEW JERSEY.

BY HARRY B. WEISS AND EDGAR L. DICKERSON.

NEW BRUNSWICK, N. J.

In the following notes which are the results of nearly a year's observations on the insects associated with *Asclepias syriaca* (*A. cornuti*), the common species of the eastern states, and *Asclepias pulchra*, which is considered a variety of *Asclepias incarnata*, special attention is paid to those species about which little or nothing has been recorded heretofore. However, in order to make the paper more complete, it was thought desirable to treat other milkweed insects briefly and to indicate where important papers relating to them could be found.

The milkweeds which are persistent perennials in many waste places are widely distributed in North America and are best recognized by their opposite or whorled leaves, flat-topped clusters of showy flowers and their milky juice. In the flowers, the stamens are united at least at the base and each of them bears a large dorsal appendage. These appendages together form the corona. Especially characteristic are the club-shaped pollen masses or pollinia. For the purpose of pollination by insects, the pollinia are attached in pairs to a corpusculum or glandular outgrowth of the stigma.

A paper on milkweed insects would not be complete without reference to Robertson's writings on the "Insect Relations of Certain Asclepiads" (Bot. Gaz., Vol. 12, 1887, pp. 207-216; pp. 244-250; Trans. St. Louis Acad. Sci., 1891, pp. 569-577). In the first paper, the various species of *Asclepias* are treated together with notes on

floral parts and the parts of the insects to which corpuscula are attached. According to Robertson, in *Asclepias incarnata*, the small anther wings are adapted to fasten the corpuscula upon the legs of large insects from the claws to the middle of the tibiæ and on the claws and tarsal hairs of the smaller ones, but they catch the hairs much more frequently. In *Asclepias cornuti*, the anthers are much larger than in *A. incarnata* and as a consequence the corpuscula are fastened to the claws of insects more frequently. The tarsal hairs are not readily caught unless they are long. However corpuscula are found more frequently on the pulvilli and on the hairs near the claws than on the claws. For references to other species of *Asclepias*, the reader is referred to Robertson's paper. At the end of the article *Asclepias* in general are treated and the following table given. This shows the number of species visiting the flowers together with the disposition of the corpuscula on them. In the table, the pulvilli are included under hairs.

	Hymen.	Butterflies.	Other Lep.	Diptera.	Coleop.	Hemiptera.	
Corpuscula on hairs, claws, tongue.....	14				2		16
Corpuscula on hairs and claws.....	8	7				1	16
Corpuscula on hairs, tongue.....	5	1		3			9
Corpuscula on hairs alone.....	26	15	1	7	2	3	54
Corpuscula on claws alone.....	3						3
Corpuscula on tongue alone.....	1			2			3
Corpuscula, none.....	13	12	6	13	5		49
	70	35	7	25	9	4	150

In the second paper in the Botanical Gazette, Robertson discusses the distribution of the pollinia on various groups of insects which visit the flowers. The third paper contains detailed lists of the flower visitors and notes on the distribution of the corpuscula.

Tetraopes tetraophthalmus Forst. (Coleop.).

This insect, known as the milkweed beetle, is common throughout New Jersey and elsewhere, feeding on the leaves, tender tips, stems, buds and flowers of several species of *Asclepias*. In New Jersey, it occurs during June, July, August and the first part of September. In the middle section of the State, the beetles were first noted on

June 19 and continued in evidence until the first part of September. The majority of them appeared to copulate during July and the first half of August.

When the beetles first appear, they feed upon the young leaves. Later the flower buds appear and these are eaten and lastly, the flowers are devoured. As a result, the plants become ragged and streaked with the milky white juice, which runs from the punctures and hardens. *Asclepias syriaca* seems to be the favorite milkweed, although beetles were observed feeding to a certain extent on the leaves and flowers of *Asclepias pulchra* and beetles were collected from the flowers of *Acerates viridiflora*, a plant resembling and related to the milkweeds. Our efforts to secure eggs of this species resulted in failure. Numerous beetles were gathered and placed in a roomy outdoor cage together with growing milkweeds and while they fed and copulated extensively, they refused to deposit eggs. However, through the kindness of Dr. F. H. Chittenden, we secured several eggs which had been deposited in confinement on leaves, by beetles collected by Mrs. D. H. Blake at Riverdale, Md., during the last of July. Females collected on July 18 and dissected were found to contain from 45 to 55 fully developed, elongate, whitish eggs. It is not known just where the eggs are laid in the field. Various parts of the plants were examined, with negative results. It seems probable, however, that they might be deposited at the base of the plant close to the main stem, in view of the fact that many larvæ are found in the lower stem and main root not far from the top of the soil.

The first larvæ were found on July 31 at Red Bank, N. J., on the main stem below the ground surface and on the larger roots. In each case they were found in shallow channels covered over more or less with soil, which stuck to the injured portions, probably because of the sticky nature of the plant juice. Later in the season, it was possible to find larger larvæ and by the middle of October, they varied from one half inch in length to apparently full grown. At this time, several large larvæ were found in the soil close to the lower main stem and among the small roots. Other large ones were found in shallow channels in the main lower stem. Still others were located under the bark of the main lower stem and out of sight, while several small ones were dug from the lower end of the main stem. These small ones were well inside the stem in irregular, longitudinal chan-

nels. When digging around the stem and roots for larvæ, it is usually possible to find some in the soil before the main root is uncovered. Therefore, some larvæ eat into the root from the outside, while others burrow to a certain extent at least a part of their time in the root itself. Mr. Craighead informs us that galleries are found extending from root to root through the earth, then continuing up to near the surface of the ground where pupation occurs.

Devereaux (Can. Ent., Vol. X, p. 143, 1878) states that while he was plowing through a patch of *Asclepias cornuti*, during the early part of June, 1876, he observed numerous cerambycidian larvæ in the bottom of the furrow, stirring about in the soil. Two of them were put in a glass jar with a milkweed plant. The larvæ soon came to the surface, pupated and adults of *T. tetraophthalmus* emerged later. Mr. Craighead is of the opinion that the larval period extends through two years as pupæ, and young larvæ can be found in the early summer.

EGG. Length, 1.85 mm. Width, 0.42 mm. Pearly white, comparatively smooth; elongate, rounded at both ends, sides almost parallel, tapering slightly to posterior end.

FULL GROWN LARVA. The following description was kindly supplied by Mr. F. C. Craighead from a paper of his now in press. A description of the pupa will also appear in a future paper by the same author. "Form robust, fleshy, cylindrical or slightly tapering posteriorly; texture very finely wrinkled, shining, densely clothed with long whitish lemon-colored hairs.

"Head rather thick but depressed, sides narrowing posteriorly, suddenly constricted about middle, widest across posterior limit of front; epistoma thick, rugulose; clypeus and labrum thick, latter transverse, roundly semi-circular from base, densely haired; mandible from side about two times the basal width, outer face rather rugulose, cutting edge obliquely truncate, molar tooth distinct; antennal cavity bisected by frontal suture; ocelli not distinct; ventral mouth parts fleshy, thick; mentum distinct, transverse; maxillary palpi two-jointed, last joint slender, shorter than the basal, equal to the last labial; hypostoma transversely bulging, finely wrinkled; gula less corneous.

"Prothorax very thick, about two times as wide as long; protergum densely hairy on sides also across anterior border; pronotum posteriorly finely velvety pubescent; prosternum densely hairy, lateral areas swollen; eusternum distinct, swollen; sternellum very narrow, transverse. Mesonotum and metanotum densely hairy, mesonotum with an anterior transverse band of hairs, posteriorly glabrous.

"Abdomen very densely hairy; ampullæ narrow, projecting in large dull tuberculiform lobes; later zone slightly protuberant on all segments, tubercles elongate, oval, bearing very many hairs and no chitinous pits; spiracles large, orbicular."

The adult was described in 1771 (Forst., Cent. Ins., p. 41) and later mentioned in various lists and publications. Several other species of *Tetraopes* have been described, most of them being associated with milkweeds.

***Rhyssematus lineaticollis* Say (Coleop.).**

This species which is listed by Smith (Ins. N. J., p. 390) as occurring in widely separated parts of the State is quite common throughout New Jersey, appearing about the first week of June and feeding at the bases of the young leaves of milkweed, especially *Asclepias syriaca*. It has long been known to breed in the seed pods of milkweed. Webster (Ins. Life, II, p. 112), in his paper on "Notes on Breeding and Other Habits of Some Species of Curculionidæ, Especially of the Genus *Tyloderma*," states that it breeds in the seed pods of *A. incarnata*, the larva feeding upon the seeds and transforming to an adult in late autumn although these notes may possibly refer to *Rhyssematus annectans* Casey, a related species which we have found breeding in the seed pods of *Asclepias pulchra* (*incarnata*). He gives a very brief general description of the larva and states that it is parasitized by a species of *Bracon*.

In addition to feeding on the young leaves early in the season, later the beetles attack the leaf petioles, midribs of leaves, seed pods and upper portions of the main stem. As a result the injured parts bleed profusely and the milky juice hardens into unsightly yellowish white streaks and blotches. In the central part of the State, eggs are laid during the last half of July. They are deposited inside the seed pod through an opening cut by the adult and can be found on the inner side of the seed pod wall, close to this opening. Many

yellowish white eggs were found in such places, the number varying from one to five. The egg scars on the seed pod are usually covered over with a yellowish white scab of dried juice and are easily located by such exudations.

Upon hatching the larvæ first feed on the inner surface of the green seed pod wall and then eat their way through the spongy tissue between the wall and the developing seeds, until the seeds are reached. Here they complete their growth, destroying more or less of the young white seeds. The number of larvæ in a single pod varies from one to twenty. When many are present the entire interior of the seed pod is consumed, nothing being left except the outer wall. By the first and second week of August many larvæ become full grown at which time they leave the seed pod through a hole in the wall and drop to the ground. Many simply crawl out if the pod is cracked open which is usually the case after much of the interior has been destroyed. After reaching the soil they enter it to a depth of about one inch and at the end of a week have transformed to pupæ. The pupal stage requires from ten days to two weeks after which several days are required for the beetles to color and harden. Emergence in large numbers takes place during the first two weeks of September and the beetles feed on the milkweeds before seeking hibernation quarters. In the northern part of the state, at Rutherford, eggs and young larvæ were found as late as August 17. There appears to be only one generation each year and we found *lineaticollis* confined entirely to *Asclepias syriaca*.

EGG. Length 0.89 mm. Width 0.39 mm. Whitish. Somewhat capsule-shaped; both ends rounded, one end slightly wider than the other; sides almost parallel; chorion apparently smooth.

FULL GROWN LARVA. Form subcylindrical, tapering slightly at both ends, slightly curved, almost smooth, whitish, head brownish. Length of mature larva about 12 mm. Width about 3 mm.

Head small, subcircular, sparsely hairy, slightly depressed; cœlum absent; occipital foramen subtriangular; epicranial halves separated dorsally by a faint median suture; front subtriangular, bearing several slightly depressed spots; gula indistinct, membranous; ventral mouth parts somewhat fleshy; maxillary sclerite indistinct, not cushioned; clypeus and labrum distinct, former transverse, latter

subtransverse; antennæ minute, single jointed, almost obsolete; ocelli absent; mandibles of biting type, broad across base, bifid at tip; maxilla fused with labium to near apex; lacinia simple, fringed with chitinous hairs on inner surface; galea absent; maxillary palpi two-jointed, first joint barrel-shaped, apical joint minute; cardo subquadrate with distal and articulating angles strongly acute; labium subquadrate with mentum and submentum fused, indistinct; labial palpi one-jointed. True legs absent, indicated by ambulatory tubercles. Thoracic and abdominal segments somewhat similar, transversely wrinkled, each with three dorsal plicæ. Hypopleural chitination absent. Cerci absent. Anal segment wart-like. Spiracles bifore.

PUPA. Length about 7 mm. Width 2.5 mm. to 3 mm. Oval, whitish. Rostrum bearing a pair of dorsal chitinized hairs below antennal insertion; a pair just opposite to where antennæ arise and a pair above near the eyes. Head with a group of three chitinized hairs on either side of middle and above the eyes. Prothorax triangular dorsally, bearing a longitudinal row of three spines on either side of a median line. Dorsal anterior edge of prothorax fringed with a row of distantly placed spines; posterior edge bearing only a few lateral spines. Mesothorax with a subhemispherical median tubercle on posterior edge; anterior to this tubercle on either side of middle are a pair of spines. Metathorax with a broad shallow, median, dorsal depression with a pair of spines on either side. Abdominal segments each with a shallow, median, dorsal depression and three spines on each side arranged transversely on a slight ridge. Abdominal segments 5, 6, 7 and 8 bear a similar pair of lateral spines. Anal segment terminated by two more chitinized dorso-lateral spines and several smaller ones. Wing cases each bearing four pronounced longitudinal rows of minute spines, these spines becoming more prominent toward bases of wing cases. Distal outer portions of femora each bearing a pair of spines. All spines with tuberculate bases.

ADULT. *Rhyssomatus lineaticollis*. This was described by Say in 1824 (Jour. Acad. Nat. Sci., Vol. 3, p. 313) from Arkansas, under the generic name *Tyloderma*. According to Blatchley and Leng (Rhyn. N. E. Amer., p. 484) it ranges from Mass., to Mich., and Kansas, south to Florida and Texas.

Rhysssematus annectans Casey (Coleop.).

This beetle which is distinguished from *R. lineaticollis* by its usually more narrow form but especially by its oblique thoracic strigæ was first thought to be identical with *lineaticollis* but the two are distinct as we have found by breeding them out. *Annectans* is recorded by Dury (Blatch. & Leng, Rhyn. N. E. Amer., p. 484) as abundant and eating out the heads of swamp milkweed (*Asclepias incarnata*), May 24 and its distribution according to Blatchley and Leng (*loc. cit.*) is Ohio, Indiana and Illinois. While not heretofore recorded from New Jersey, we have found it to be a common species occurring in numbers and breeding in the stems and seed pods of *Asclepias pulchra* at Riverton, Monmouth Junction, New Brunswick and several other places in the State. We have not found *annectans* associated with any other milkweed except *Asclepias pulchra*.

In New Jersey, the adults appear during June and by the middle of this month are in full evidence. Before and at this time feeding takes place on the stems and terminal leaves. In addition the leaf petiole and midrib are also attacked. In many cases, the stem is riddled with circular feeding and egg laying punctures. The presence of many beetles is readily detected by the wilted tops of the plants, due to excessive injury. In time, the tissue around the stem punctures becomes hard, corky and discolored.

During the last ten days of June, eggs are deposited, these being placed at the bottoms of channels eaten in the stems sometimes almost to the pith, the openings of the channels being closed by whitish scabs of tissue and plant juice, which eventually dry and fall off. Eggs are deposited singly, mainly in the lower half of the stem, although all parts of the stem are utilized for this purpose except the extreme tip. Both egg and feeding punctures are similar on the stem but egg punctures can be detected early by the scab-like coverings. Later, both become hard, corky and discolored around the edges. From two to ten eggs were found in stems eight inches in length and later, the number of larvæ in a stem varied from one to nine. Some stems were completely covered with egg and feeding punctures, sixty being counted on a stem one foot high.

By the last week of July many partly grown larvæ are in evidence.

After hatching they burrow just under the bark and later usually down but sometimes up the stem in the tissue and pith, making irregular, longitudinal channels, sometimes hollowing the stem completely out. During the second week of July, pupæ were found, this stage taking place in the larval channels. During the last week of July and first week of August adults appear, having emerged through circular holes in the stem.

This completes the first brood. During the last of August and first part of September, these adults deposit eggs in the seed pods of *Asclepias pulchra*, these being laid singly inside the pod just beneath the outer covering. Egg punctures can be located by the reddish discolorations around them. A small amount of sap runs from these punctures but nothing like the amount which exudes from *syriaca* seed pods when punctured by *lineaticollis*. From one to nine eggs were found in a single pod. After hatching the larvæ feed on the developing seeds usually in the centre of the mass and when full grown pupate in cells composed of frass, etc., in the middle basal portion of the seed cluster. During the first part of October many pupæ were found. By this time all of the infested pods had split open on one side exposing the seeds; the seeds however do not disperse being webbed up and held together. During the first ten days of October the beetles leave the infested seeds and disappear. Shortly afterward, the seeds and parts of seeds fall from the plant.

EGG. Slightly smaller, but otherwise similar to that of *lineaticollis*.

LARVA. Slightly smaller but otherwise apparently similar to that of *lineaticollis* except that in specimens which we examined, there appear to be slight variations in the arrangement of the body hairs. There are also variations in the lengths of the body hairs but on the whole, those of *lineaticollis* are slightly longer than those of *annectans*.

PUPA. Apparently similar to that of *lineaticollis* except that the tubercles, spines and hairs are weaker. Size slightly smaller than that of *lineaticollis*.

ADULT. *Rhyssomatus annectans*. This was described by Casey in 1895 (Annals N. Y. Acad. Sci., VIII, p. 834) "from the Levette cabinet but without labels" and probably from Indiana.

Chelymorphe argus Licht. (Coleop.).

This species known as the argus tortoise beetle is recorded by Blatchley (Col. Ind., p. 1233) as throughout Indiana, frequent, April 7 to August 11, on milkweed and wild potato. Smith (Ins. N. J., p. 356) says, common on *Convolvulus* and *Asclepias*, but we have not found it to be common on the latter. In the U. S. D. A. Yearbook (1908, p. 579) it is mentioned as injuring morning glory and moonflower vines in western Texas. Webster and Mally (Bull. 17, n. s., Div. Ent. U. S. D. A., p. 99, 1898) state that adults were reared from larvæ found in Ohio on strawberry vines.

It is probably best known as a wild morning glory and sweet potato pest and as such is treated by Crosby and Leonard in their Manual of Vegetable Garden Insects (1918, p. 238). Additional food plants given by these authors are sunflower and horse radish. Sanderson (Ins. Pests Farm Garden, Orchard, p. 436) figures the eggs, larvæ and adults and gives short descriptions. Chittenden (Bull. 9, n. s., Div. Ent. U. S. D. A., p. 23, 1897) gives an account of its activities on sweet potatoes, and also mentions the larva as feeding on *Asclepias* but states that they prefer *Convolvulus*. Packard in his "Guide" (p. 504) recorded the beetles as abundant on the leaves of raspberry.

Oncopeltus fasciatus Dallas (Hemip.).

Known as the milkweed bug, this species is well distributed throughout New Jersey, occurring principally on *Asclepias syriaca* but being found on other milkweeds as well. Adults appeared to be most plentiful during July and October, although they were found from June on. The adults hibernate and deposit their elongate light red eggs in loose masses on the young milkweeds during the spring. The nymphs and adults also feed on these plants, usually occurring in colonies. Essig (Inj. and Ben. Ins. Cal., 2d ed., Suppl. Mon. Bul. Cal. St. Comm. Hort., Vol. IV, no. 4, 1915) gives a brief account of this species and mentions *Lygæus reclinatus* Say as another common milkweed bug. Morrill (U. S. Bur. Ent. Bul., 86, p. 93, 1910) in his paper on plant bugs injurious to cotton bolls writes as follows, "two large lygæids, *Oncopeltus fasciatus* Dall., and *Lygæus turcicus* Fab.,¹ were common on cotton at Tlahualilo, Durango, Mex-

¹ Mr. H. G. Barber suggests that this may be *Lygæus kalmii*.

ico, in July, 1905, and young of both species were found feeding on alfalfa. They have been observed to attack cotton squares and bolls. Milkweeds (*Asclepias* spp.) seem to be the natural food plants of both of these species."

EGG. Heidemann (Proc. Ent. Soc. Wash., Vol. XIII, no. 3, p. 133, 1911) has the following to say about the egg. "*Oncopeltus fasciatus* has oval-elongate eggs, a little shorter in size than those of the preceding species (*Belonochilus numenius*). The chorial process is very short and thin at the base and the round downward-bent portion quite big; there are 12 processes surrounding the upper end of the egg. The outer chorion smooth, yellowish-red." A drawing of the egg accompanies this reference.

LAST STAGE NYMPH. Length 9 to 11 mm. Width, 3.5 to 4 mm. Elongate oval, widest across middle portion of abdomen, tapering gradually to head; posterior portion of abdomen broadly rounded. Head triangular, obtusely angled in front, slightly rugose, with more or less pronounced, median, dorsal, slight, broadly rounded ridge extending from apex to middle portion, posterior to which is a slight, curved, transverse depression. Antennæ linear, finely pubescent, about one half as long as body, inserted laterally, four jointed, basal joint short, second three times as long as basal, third shorter than second, distal joint equal to second and obtusely rounded. Eyes lateral, prominent. Prothorax almost twice as wide as long, anterior margin concave, sides straight gradually widening to posterior margin which is subconcave. Mesothorax slightly wider, with wing-pads reaching posterior margin of third abdominal segment. Lateral margins of wing-pads slightly rounded. Sides of abdominal segments slightly rounded. Rostrum four jointed reaching beyond posterior margin of thorax. Legs finely pubescent, comparatively long and slender. Color, reddish orange except for the following portions which are dark to black;—antennæ, legs, rostrum, upper portion of head (in most specimens), eyes, posterior margin of prothorax, lateral portions of dorsum and all of the wing-pads of the mesothorax, lateral spots on all of the abdominal segments and median dorsal spots on the fifth, sixth, seventh, eighth and ninth abdominal segments, apex of ventral abdominal surface.

ADULT. *Oncopeltus fasciatus*. This species was named by Dallas

(Brit. Mus. Hemip. Insects, 1, 2, 1851-1852, p. 538) from a description drawn up by Herrich-Schaffer who apparently misidentified Fabricius's *aulicus* (Wanzenartigen Insecten, 1842, Band VI-IX, pp. 76-77). Dallas (loc. cit.) in addition to the United States, lists specimens as having been received from Mexico, Brazil, Colombia and British Guiana. Van Duzee in his check list gives numerous references to the species and the localities listed indicate a wide distribution in the United States.

***Lygæus kalmii* Stal. (Hemip.).**

In Ent. Amer., Vol. III, p. 53, 1887, Townsend under the name *Lygæus turcicus* Fab., calls attention to the early papers dealing with the feeding habits of this species and notes his own observations on this insect in Michigan. He states that it is common on *A. tuberosa* and sometimes on *A. syriaca*, being found from June to September and that it probably hibernates as an adult. He speaks of obtaining from 6 to 35 eggs from various females. In New Jersey, *Lygæus kalmii* occurs throughout the State from April to October, on several species of milkweeds.

***Agromyza pusilla* Mg. (Dip.).**

The milkweed leaf miner *Agromyza pusilla* Mg., is a common species throughout New Jersey especially on *Asclepias syriaca*. The mines consist of irregular, whitish blotches on the upper leaf surface. Sometimes the mines run together forming a large blotch, which takes up a considerable portion of one half of the leaf. As a rule, the mines start between the side veins and some often have two parallel sides due to the failure of the larva to mine beyond the veins. The number of mines in a leaf varies from one to several. When full grown the larvæ leave the mines and fall to the ground where they pupate in soil cracks, under leaves, etc. There are several generations in New Jersey and larvæ can be found almost any time from the middle of May to the middle of September. *Asclepias pulchra* leaves were not mined to the same extent as those of *Asclepias syriaca* and in *pulchra* the edges of the mined area were somewhat reddish. It was noted that almost any kind of insect injury to *pulchra* resulted in reddish discolorations around the injured portions.

There are several accounts of this species in European literature.

Goureau in the *Annales de la Society Entomologique de France* (Vol. IX, p. 138, 1851) figures the mine, adult, larva, etc., and gives an account of injury to the leaves of *Euphorbia cyparissias* also mentioning a parasite, *Dacnusa incerta* G. In New Jersey, at New Brunswick, on July 10, a parasite of the larva was secured and identified by Mr. S. A. Rohwer as *Opius* n. sp.

A very complete account of this leaf-miner is given by Webster and Parks (Jour. Ag. Res., Vol. I, no. 1, 1913) under the title, "The Serpentine Leaf Miner." This account gives a history of the species in Europe, its wide distribution in the United States, its life history, notes on food plants, descriptions of the various stages and notes on parasites together with advice for controlling its injuries to alfalfa and forage crops. It has a wide range of food plants including cabbage, nasturtium, radish, potato, turnip, spinach, cowpeas, watermelon, beet, pepper, vetch, sweet pea, clover, rape, cotton, tobacco, alfalfa, etc., and was apparently first recorded in America by Riley in 1876.

MILKWEED MIDGES.

Dr. E. P. Felt under the title "Hosts and Galls of American Gall Midges" (Jour. Econ. Ent. Vol. IV, p. 454, 1911) and in his "Key to American Insect Galls" (N. Y. St. Mus. Bul., 200, p. 180) gives the following information under *Asclepias*.

- Elongate fusiform stem gall on *A. incarnata*.....*Neolasioptera asclepiæ*.
 Rusty brown irregularly swollen young leaves on *A.*
incarnata.....*Cecidomyia* sp.
 Oval, mid-rib, tumid fold, length 7 mm., diam. 4 mm.
 on *A. incarnata*.....*Cecidomyia* sp.
 Reared from rolled leaf of *A. syriaca*.....*Lestodiplosis asclepiæ*.

At New Brunswick, N. J., on July 31, whitish, midge larvæ were found in the rolled edges of the leaves of *Asclepias syriaca*. The edges were rolled downward and the larvæ occurred in colonies of from five to twelve. No adults were secured but it is probable that the species was *Lestodiplosis asclepiæ* Felt.

Danaus archippus Fabr. (Lep.).

Very little need be said about the Monarch butterfly which occurs over the entire continent as far north as southern Canada. In New

Jersey, it can be found from May until November, sparingly before midsummer and commonly until late September. The larva is bright yellow or greenish yellow banded with shining black and furnished with black, fleshy, thread-like appendages on the second thoracic and eighth abdominal segments. It feeds on several species of *Asclepias* and in New Jersey there are three broods. This butterfly migrates in late fall. In May scattering females (and males according to Mr. W. T. Davis) return and provide for the first brood of larvæ. The adults developing from these eggs give rise to a second brood of larvæ and the butterflies developing from the third brood of larvæ leave in swarms for the south during late September and early October.

Various references to publications on the life history and habits of this species can be found in Edwards' Catalogue (Bull. 35, U. S. Nat. Mus.) and numerous papers on this insect have appeared in the entomological journals and popular magazines. An interesting account of the migration of this species and its routes to the south and return can be found in a paper by Mr. Howard J. Shannon entitled "Insect Migrations as Related to Those of Birds" (Scientific Monthly, Sept. 1916).

Anosia berenice Cramer (Lep.).

This and the variety *strigosa* Bates which are confined to the southern portions of the United States and South America are also *Asclepias* feeders. Edwards (Bull. 35, U. S. Nat. Mus., p. 18) lists references to the literature on the larva of *berenice*.

Mamestra legitima Grt. (Lep.).

In Insect Life (Vol. II, p. 382, 1889-1890) this species is recorded as having been reared during the spring of 1889 from a larva found feeding within a seed pod of *Asclepias incarnata* near LaFayette, Indiana, early in November, 1888. Howard (U. S. D. A. Yearbook, 1898, p. 142) figures the larva, pupa and adult of this species and notes its occurrence and injury in tobacco fields of southern Virginia. Chittenden (Bul. 10, n. s., Div. Ent. U. S. D. A., p. 60, 1898) states that larvæ were found on asparagus plants at Marshall Hall, Md., October 12, 1896. Smith (Ins. N. J., p. 457) records the food

plants as asparagus, beans, cabbage, and a variety of other garden plants. From the above statements, it is evident that *Mamestra legitima* is somewhat of a general feeder but not a species one is likely to find commonly associated with milkweeds.

Euchætias egle Drury (Lep.).

The tufted larvæ of this species occur on milkweed in various sections of New Jersey but during the season of 1920 they were not at all numerous. There are two broods in New Jersey, the moths appearing in June and again in late July and August. Various species of *Asclepias* are recorded as food plants, chief among these being *A. cornuti*. Jewett (Can. Ent., Vol. XII, p. 230, 1880) describes the eggs and first stage larva and states that his notes carry the life history of the insect to the point where Lintner begins. Lintner (24th Rept. N. Y. St. Mus. Nat. His., pp. 136-137, 1870) describes the larvæ after each moult and the cocoon. Edwards (Papilio, Vol. III, p. 147, 1883) also describes the larva in addition to the adults of the spring and fall broods. The adult was described by Drury in 1773 (Ill. Exot. Ent., ii, pl. 20; f. 3) and its distribution is given by Dyar (Bull. 52, U. S. Nat. Mus.) as the Atlantic States.

Ammalo tenera Hubner (Lep.).

This is one of the common tiger moths of the Atlantic States and has been recorded by various authors as feeding on *Asclepias*. Its preferred food plant however appears to be *Apocynum*. Numerous references to the early stages are given by Edwards (Bull. 35, U. S. Nat. Mus.) under the name *Euchætës collaris* Fitch and need not be gone into here.

Pygarctia eglenensis Clem. (Lep.).

Edwards (Papilio, Vol. III, p. 147, 1883) under the generic name *Euchætës* describes the larvæ and adults of the fall and spring broods of this species and gives *Asclepias* spp., especially *A. tuberosa*, as food plants. The adult was described by Clemens (Proc. Acad. Nat. Sci. Phil., XII, 533, 1860) and its distribution is given by Dyar (*loc. cit.*) as South Atlantic States. It is recorded in "Insects of Florida" (Bull. Amer. Mus. Nat. His., Vol. XXXVIII, Art. 1, pp. 1-147, 1917, IV Lep.) with the statement, "extends through the Atlantic States to New York."

PLANT LICE (HOMOP.).

Plant lice were unusually abundant throughout the season, especially on *Asclepias syriaca* and *Asclepias pulchra*, in fact often times, these were the sole insect associates of the plants. The following species were kindly identified by Prof. C. P. Gillette.

Aphis lutescens Mon. New Brunswick, N. J., July 9, plentiful on leaves and stems of *A. pulchra* until frost. Plentiful on stems of *A. syriaca* especially near ground during the fall.

Aphis asclepiadis Fitch. Riverton, N. J., June 22, plentiful on *A. syriaca*.

Myzocallis asclepiadis Mon. New Brunswick, N. J., May 30, plentiful on *A. syriaca*.

Aphis sp. Hanover Farms, N. J., June 10, plentiful on *A. syriaca*.

For additional species occurring on milkweeds, see Wilson and Vickery, List of Aphididæ of World (Tr. Wis. Acad. Sci. Art. Let., Vol. XIX, part 1) and Dr. E. M. Patch, Food Plant Cat. of Aphididæ of World, Part VI (Bul. 282, Me. Ag. Exp. Sta.).

Tetranychus telarius Linn. (Acar.).

At Monmouth Junction, N. J., on June 19, several plants of *Asclepias syriaca* were found to be heavily infested and badly injured by mites. Elderberry adjoining the milkweeds was also severely infested. The species was identified by Dr. H. E. Ewing as our common spider mite *Tetranychus telarius* Linn.

OTHER INSECTS ASSOCIATED WITH MILKWEEDS.

The following list of records, dealing for the most part with flower visitors, is necessarily incomplete. Systematic collecting would result in the addition of many new names.

NEUROPTERA.

Chrysopa interrupta Schneid. New Brunswick, N. J., July 4, visiting flowers of *A. syriaca* at night.

HOMOPTERA.

Aspidiotus perniciosus Comst. Listed as attacking milkweed (probably a woody kind) (Essig, Inj. and Ben. Ins. Cal., 1915, p. 180).

HEMIPTERA.

- Mormidea lugens** Fab. Elizabeth, N. J., Aug. 4, on *A. pulchra* flowers.
- Thyreocoris pulicaria** Germ. So. River, N. J., July 17, plentiful on flowers of *A. syriaca*.
- Lygæus kalmii** Stal. Riverton, N. J., June 22, on *A. syriaca*.
- Microphylellus modestus** Reut. Monmouth Jc., N. J., June 19, on *A. syriaca*.
- Phymata erosa** Linn. Elizabeth, N. J., August 4, numerous in flowers of *A. pulchra*.
- Adelphacoris rapidus** Say. Monmouth Jc., N. J., July 19, on *A. syriaca*.
- Paracalocoris colon** Say. Washington's Crossing, N. J., June 10, on *A. syriaca*.
- Neurocolpus nubilus** Say. Monmouth Jc., N. J., July 14, on *A. pulchra* flowers.
- Stenotus binotatus** Fab. Riverton, N. J., June 22, on *A. syriaca*.
- Pæciloscytus basilis** Reut. So. River, N. J., July 17, on *A. syriaca*.

COLEOPTERA.

- Adalia bipunctata** L. Riverton, N. J., June 22, on *A. syriaca*.

This and the following species of coccinellids were associated with plant lice.

- Megilla maculata** DeG. Monmouth Junction, N. J., July 17, on *A. syriaca*.
- Hippodamia convergens** Guer. Monmouth Jc., N. J., July 17, Riverton, N. J., June 22, on *A. syriaca*.
- Coccinella novemnotata** Hbst. South River, Red Bank, July 30, Riverton, June 22, on *A. syriaca*. Rutherford, August 25, on *A. tuberosa*. All localities in N. J.
- Coccinella trifasciata** L. Monmouth Jc., N. J., June 19, on *A. syriaca*.
- Brachyacantha ursina** Fabr. So. River, N. J., July 12, on *A. syriaca*; Washington's Crossing, N. J., on *A. syriaca* flowers.
- Scymnus indutus** Csy. Riverton, New Brunswick, N. J., June 10, July 24, on leaves of *A. syriaca*.
- Antherophagus ochraceus** Mels. So. River, N. J., June 17, on flowers of *A. syriaca*.

- Monocrepidius lividus** DeG. So. River, N. J., July 17, on leaves of *A. syriaca*.
- Lucidota atra** Say. Monmouth Jc., N. J., June 19, on leaves of *A. syriaca*.
- Pyropyga decipiens** Harr. Deal Beach, N. J., July 20, on *A. pulchra* flower buds. Monmouth Jc., N. J., June 19, on leaves of *A. syriaca*.
- Chauliognathus marginatus** Fabr. Monmouth Jc., N. J., June 19, July 17, on leaves and flowers of *A. syriaca*.
- Popillia japonica** Newm. Riverton, N. J., July 27, feeding on *A. syriaca* flowers.
- Macroductylus subspinosus** Fabr. Washington's Crossing, N. J., feeding on *A. syriaca* flowers.
- Anomala lucicola** Fabr. Monmouth Jc., N. J., July 17, on flowers of *A. syriaca*.
- Leptura velutinus** Say. Chester, N. J., July, on *A. syriaca*.
- Tetraopes canteriator** Drap. Throughout New Jersey, local, on milkweeds.
- Labidomera clivicollis** Kirby. Various parts of New Jersey, larvæ and adults feeding on leaves of *A. incarnata*, *A. syriaca* and *A. pulchra*. June, July, August.
- Chrysochus cobaltinus** Lec. Milkweeds, oleander, orchard trees (Essig, Inj. and Ben. Ins. Cal., 1915, p. 259).
- Gastroidea cyanea** Mels. Somerville, N. J., June 30, feeding on leaves of *A. syriaca*.
- Diabrotica 12-punctata** Oliv. Riverton, N. J., June 22, on *A. syriaca*.
- Coptocycla guttata** Oliv. Beatystown, N. J., July, on *A. incarnata*.
- Coptocycla aurichalcea** Fabr. Monmouth Jc., N. J., on *A. syriaca*.
- Epitrix cucumeris** Harris. Princeton Jc., N. J., July 28, very abundant on leaves of *A. syriaca* (det. W. A. Hoffmann).
- Mordella octopunctata** Fabr. Monmouth Jc., N. J., July 14, on flowers of *A. pulchra*.
- Mordella scutellaris** Fabr. Elizabeth, N. J., August 4, on flowers of *A. pulchra*; So. River, N. J., July 17, on *A. syriaca* flowers.
- Epicauta vittata** Fabr. Rahway, N. J., August 6, feeding on *A. pulchra* flowers.
- Gymnetron teter** Fabr. Monmouth Jc., N. J., June 19, on leaves of *A. syriaca*.

Glyptobaris rugicollis Lec. On milkweed (Blatchley and Leng, Rhyn. N. E. Amer., p. 366).

Odontocorynus salebrosus Csy. On milkweed (Blatchley and Leng, Rhyn. N. E. Amer., p. 386).

Odontocorynus scutellum-album Say. Elizabeth, N. J., August 4, on flowers of *A. pulchra*; So. River, N. J., July 17, on flowers of *A. syriaca*.

LEPIDOPTERA.

Danaus archippus Fabr. New Brunswick, N. J., August 8, visiting flowers of *A. pulchra*.

Phyciodes tharos Dru. New Brunswick, N. J., July 31, Deal Beach, N. J., July 2, on *A. pulchra* flowers.

Heodes hypophlæas Boisd. Elizabeth, N. J., July 20, visiting *A. syriaca* flowers.

Pieris rapæ L. Riverton, N. J., June 22, visiting *A. pulchra* flowers.

Colias philodice Gdt. Riverton, N. J., June 22, visiting flowers of *A. pulchra*.

Papilio polyxenes Fabr. New Brunswick, N. J., August 8, visiting *A. pulchra* flowers.

Atrytonopsis verna Edwards. Elizabeth, N. J., visiting flowers of *A. syriaca*.

Poanes massasoit Scud. Princeton Jc., N. J., July 28, visiting *A. pulchra* flowers.

Ancyloxypha numitor Fab. Riverton, N. J., August 5, visiting *A. pulchra* flowers; Washington's Crossing, N. J., June 28, plentiful at *A. syriaca* flowers.

Epargyreus tityrus Fabr. Princeton Jc., N. J., July 28, visiting *A. syriaca* flowers.

Hæmorrhagia thysbe Fabr. Elizabeth, N. J., August 4, visiting *A. pulchra* flowers.

Scepsis fulvicollis Hbn. Princeton Jc., N. J., July 28, visiting *A. pulchra* flowers.

Apamea velata Walker. New Brunswick, N. J., July 14, visiting *A. syriaca* flowers at night.

Autographa falcifera f. **simplex** Kirby. New Brunswick, N. J., July 14, visiting *A. syriaca* flowers at night.

Melititia satyriniformis Hbn. Red Bank, N. J., July 30, visiting *A. syriaca* flowers.

Crambus albellus Clem. New Brunswick, N. J., July 14, visiting *A. syriaca* flowers at night.

Archiceps rosaceana Harr. Rutherford, Dayton, New Brunswick, N. J., July, August. Larvæ in rolled edges of leaves of *A. syriaca* and in pulled-together terminal leaves.

HYMENOPTERA.

Perilampus hyalinus Say. Chester, N. J., July, visiting flowers of *A. syriaca*.

Lasius niger americanus Emery. Riverton, N. J., June 22, attending plant lice on *A. syriaca*.

Formica fusca subsericea Say. New Brunswick, N. J., June 24, attending plant lice on *A. syriaca*.

Formica pallide-fulva nitidiventris Emery. Riverton, N. J., June 22, on *A. syriaca*.

Campsomeris plumipes Drury. Riverton, N. J., June 22, visiting *A. syriaca* flowers and caught by *A. pulchra* flowers.

Elis quinquecincta Fabr. New Brunswick, N. J., July 31, August 8, visiting *A. pulchra* flowers.

Polistes pallipes Le Pel. New Brunswick, N. J., July 31, visiting *A. pulchra* flowers.

Amnobia ichneumonea L. Riverton, N. J., August 5, visiting *A. pulchra* flowers. Flower visitor of *Asclepias* (Hymen. Conn., p. 680).

Priononyx bifoveolatum Tasch. Hammonton, N. J., August 3, visiting *A. tuberosa* flowers.

Cerceris clypeata Dahl. Riverton, N. J., June 23, visiting *A. syriaca* flowers.

Philanthus politus Say. On milkweed flowers (H. L. V.), June 27 (Hymen. Conn., p. 675).

Microbembex monodonta Say. So. River, N. J., July 17, visiting *A. syriaca* flowers.

Oxybelus quadrinotatus Say. On milkweed flowers, July, August (Hymen. Conn., p. 660).

Chloralictus pruinus Rob. Riverton, N. J., June 22, visiting *A. syriaca* flowers.

Chloralictus zephyrus Smith. Riverton, So. River, N. J., June 22, July 17, visiting *A. syriaca* flowers.

- Chloralictus pilosus** Smith. Riverton, N. J., June 22, visiting *A. syriaca* flowers.
- Chloralictus nymphæarum** Rob. Riverton, N. J., June 22, visiting *A. syriaca* flowers.
- Evyllæus pectoralis** Smith. So. River, N. J., July 17, visiting *A. syriaca* flowers.
- Halictus viridissimus** Vier. Visiting milkweed flowers, June, August (H. L. V.) (Hymen. Conn., p. 705).
- Anthemoessa bomboides** Cress. Chester, N. J., July, visiting *A. syriaca* flowers.
- Hylæus modestus** Say. On flowers of milkweed, June, July, August (Hymen. Conn., p. 739).
- Megachile brevis** Say. Riverton, N. J., June 22, visiting flowers of *A. syriaca*.
- Megachile infragilis** Cress. Taken on milkweed flowers (Hymen. Conn., p. 745).
- Cœlioxys octodentata** Rob. So. River, N. J., July 17, visiting *A. syriaca* flowers.
- Bremus perplexus** Cress. Chester, N. J., July, visiting *A. syriaca* flowers.
- Xylocopa virginica** Drury. New Brunswick, N. J., July 31, visiting *A. pulchra* flowers.
- Bombias separatus** Cress. Chester, N. J., July, visiting *A. syriaca* flowers.

Throughout the season, many honey bees were observed visiting the flowers of *A. syriaca* and *A. pulchra*.

DIPTERA.

- Scatopse brevicornis** Mg. Riverton, N. J., June 22, visiting *A. syriaca* flowers (det. Malloch).
- Syrphus rectus** O. S. Elizabeth, N. J., August 4, visiting *A. pulchra* and *A. syriaca* flowers (det. Johnson).
- Sphærophoria cylindrica** Say. Riverton, N. J., July 26, visiting *A. syriaca* flowers; Wyckoff, N. J., July 28, larva feeding on aphids on *A. syriaca* (det. Johnson).
- Toxomerus marginata** Say. So. River, N. J., July 17, visiting *A. syriaca* flowers (det. Johnson). For an interesting account of this

fly and its relation to *Apocynum* flowers, see Osburn (Ohio Jour. Sci., Vol. XX, No. 7, May, 1920).

- Eristalis arbustorum** Linn. Elizabeth, N. J., July 20, visiting *A. syriaca* flowers (det. Johnson).
- Helophilus chrysostoma** Wied. So. River, N. J., July 17, visiting *A. syriaca* flowers (det. Johnson).
- Helophilus distinctus** Will. So. River, N. J., visiting flowers of *A. syriaca* (det. Johnson).
- Conops xanthopareus** Will. New Brunswick, N. J., visiting *A. pulchra* flowers (det. McAtee).
- Cistogaster immaculata** Maq. Elizabeth, N. J., August 4, visiting *A. pulchra* flowers (det. Malloch).
- Trichopoda pennipes** Fabr. Princeton Jc., N. J., July 29, visiting *A. syriaca* flowers (det. Johnson).
- Pollenia rudis** Fabr. New Brunswick, N. J., July 5, caught by *A. syriaca* flowers (det. Malloch).
- Lucilia sericata** Mg. Elizabeth, N. J., July 20, caught by *A. syriaca* flowers (det. Malloch).
- Phormia terræ-novæ** Desv. New Brunswick, N. J., July 5, caught by *A. syriaca* flowers (det. Malloch).
- Elachiptera costata** Loew. New Brunswick, N. J., September 10, bred from decayed seed pods of *A. syriaca* (det. Johnson). Coquillett (Bull. 11, n. s., U. S. D. A., Div. Ent.) records the following facts about this species:—bred from oats and fall wheat plants; bred from larvæ found in decayed cavity in roots of radish and from larvæ found in a decayed melon root.
- Egle radicum** L. So. River, N. J., July 17, caught by *A. syriaca* flowers (det. Malloch). In Smith's Insects of New Jersey, p. 791, this is listed as the radish maggot, often troublesome.
- Rivellia quadrifasciata** Macq. Riverton, N. J., July 26, on *A. pulchra* (det. Johnson).
- Chætochlorops inquilina** Coq. New Brunswick, N. J., September 16, bred from decayed seed pods of *A. syriaca* (det. Johnson). These pods were first injured by the larvæ of *Rhysssematus lineaticollis*. Coquillett (*loc. cit.*) lists this species as having been bred from the following:—from a cecidomyiid gall on aster; from a puparium found in a cavity in apple, doubtless made by the codling

moth; from twigs of *Cephalanthus occidentalis*, these twigs being infested by the larva of *Laverna cephalanthiella* Chamb.; from egg sac of a spider and from a berry of *Solanum carolinense*.

Agromyza pusilla Mg. New Brunswick, N. J., August 15, and various parts of New Jersey. Mining leaves of *A. syriaca* and *A. pulchra* (det. Malloch).

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SOME NEW GENERA AND SPECIES OF COLEOPTERA COLLECTED AT WESTFIELD, CHAUTAUQUA CO., N. Y.

BY HOWARD NOTMAN,

BROOKLYN, N. Y.

In a collection of Coleoptera made by the writer from May 16th to 30th, 1919, the following species were found which are believed to be undescribed. Two seem to require the erection of new genera. The following correction should be noted in the "Coleoptera Collected at Windsor," etc. (JOURNAL N. Y. ENT. SOC., XXVIII, p. 181). *Daya ingrattula* Csy. should be *Traumacia ingrattula* Csy.

***Amara teres* new species.**

Form broad, convex, moderately shining; elytra (♀) very finely alutaceous. Color black, feebly æneous throughout with the exception of the three basal joints of the antennæ and the extreme base of the fourth which are pale rufo-testaceous. Head less than one half as wide as the thorax, slightly transverse, narrower than the apex of the thorax; eyes convex, frontal striae subobsolete; antennæ reaching the base of the thorax, third joint carinate at base; mentum tooth broad, subtruncate at apex with a setiferous puncture either side. Thorax rather more than three fifths wider than long, slightly narrower than the elytra, sides subparallel in basal half, rather strongly convergent but feebly arcuate anteriorly, anterior angles prominent, apex emarginate, posterior angles right, very narrowly rounded, base bisinuate, punctures about equidistant from the basal and side margins; outer basal fovea subobsolete, inner short, linear, rather deep, median line and transverse impressions subobsolete, surface without trace of punctuation. Elytra very short, not more than one fourth longer than wide, sides subparallel and very feebly arcuate to apical third, thence strongly arcuately narrowed to apex, scutellar stria with an ocellate puncture at its base, striae fine, minutely subpunctate, intervals very feebly convex, much more strongly so apically; ocellate punctures of the eighth stria scarcely more widely spaced medially. Beneath impunctate. Intermediate femora with three setæ. Abdomen with two setæ either side at apex. Three basal joints of posterior tarsi more or less distinctly grooved externally. Length 8.5 mm., width 4. mm. 1 ♀.

Type ♀ 22 May.

The broad and somewhat parallel form of this species recalls the *insignis* group. The carinate third antennal joint and the ocellate scutellar stria places it with *A. fallax* Lec.

***Hydræna angulicollis* new species.**

Form rather short, oblong, scarcely oval, convex, moderately shining. Color, head black, thorax brownish testaceous with a large rounded median piceous spot, elytra piceous with paler margins; body beneath black, epipleuræ, legs and antennæ pale. Head three fourths the width of the thorax, as wide as the thorax at apex, slightly transverse, coarsely and closely punctured, labrum acutely emarginate. Thorax three fifths wider than long, four fifths the width of the elytra, widest slightly behind the middle, sides straight and very slightly convergent anteriorly, anterior angles strongly rounded, sides strongly sinuate posteriorly forming a strong angulation where the thorax is widest, base slightly narrower than the apex, sides anteriorly vaguely concave, surface rather coarsely and closely punctured but not confluent, a narrow median smooth space. Elytra scarcely a third longer than wide, humeri somewhat prominent though strongly rounded, sides parallel to behind the middle, thence strongly arcuate to apex. Elytral punctures coarse and close, serial

arrangement rather indistinct, interspaces less than the diameters of the punctures. Length 1.7 mm., width .7 mm. 1 specimen.

Type 21 May. 1

This species seems very distinct by reason of its angulate thorax, distinct elytral humeri and indistinctly serial punctuation of the elytra. *H. brevis* described from Guatemala by Sharp seems to have much the same form but the thorax is said to be densely rugose and uneven.

Genus **Cainosternum** new genus.

Head strongly transverse, short before the eyes, without antennal grooves, clypeus broadly rounded, labrum emarginate. Eyes convex, rather prominent. Antennae short, eleven jointed, first joint stout, second a little more slender but of equal length, third longer, attenuate basally, fourth distinctly elongate, six as long as wide, seven to ten forming an abrupt elongate club, eight smaller than seven or nine.

Maxillary palpi with the second joint slightly elongate, third joint as long as broad, slightly obconic, terminal joint elongate conic, much longer than the three preceding taken together.

Labial palpi with the terminal joint suboval, twice as long as wide, as long as the two preceding which are subglobular.

Prosternum short before the coxæ, finely but strongly carinate medially; coxal cavities closed behind and angulate externally, trochantin distinct. Mesosternum extending to the middle of the intermediate coxæ which are rather narrowly separated, very strongly carinate, carina interrupted by a rather deep transverse medial groove, the anterior portion of the carina with its apex projecting posteriorly over the groove, not contiguous with the posterior section of the carina which is but slightly produced. Transverse groove limited anteriorly by a fine transverse carina. Metasternum of moderate length, posterior coxæ contiguous.

Legs moderate; femora strongly compressed; tibiæ very slender and cylindrical; tarsi moderate, joints 5-4-4.

This genus is related to *Anisotoma* (Silphidæ) but is distinguished by the more elongate and strongly conical terminal point of the maxillary palpi, the carinate prosternum, highly developed mesosternal carination but especially by the slender, cylindrical tibiæ and

the tarsal formula. In form and elytral sculpture it resembles the genus *Liodes* but the head is without antennal grooves. The terminal joint of the maxillary palpi is strongly conical in *Liodes* also.

***Cainosternum imbricatum* new species.**

Form rather broadly oval, convex. Color piceous black, strongly shining; basal joints of the antennæ, legs and under side dark piceo-rufous. Head rather more than one half the width of the thorax, sparsely but not finely punctate. Head and thorax very finely micro-reticulate, reticulations rather large. Thorax more than twice as wide as long, as wide at base as the elytra, strongly narrowed anteriorly, sides feebly arcuate, apex rather deeply emarginate, posterior angles obtuse but distinct, surface sparsely punctate, punctures finer medially than those of the head, about as coarse externally. Elytra one fourth longer than wide, widest at base, sides parallel for basal third thence evenly arcuate to the apex. Sutural stria strongly impressed apically, other striae barely traceable; with eight rows of rather fine, closely placed punctures, punctures finer than those on the head, intervals with irregular, incomplete and sparser double series of more minute punctures, surface imbricate but not at all reticulate. Imbrications very fine but sharp, difficult to find because of the high lustre of the surface, equally distinct throughout. Metasternum and abdomen finely alutaceous; epipleuræ strongly concave. Length 2.5 mm., width 1.3 mm. 1 specimen.

Type 26 May.

This species is easily recognized by the characters given. It is possible that the middle tarsi may be five jointed in the male as in the genus *Liodes*.

***Bledius verticalis* new species.**

Form somewhat robust. Color black, antennæ, legs and elytra bright rufous, the latter blackish basally and narrowly along the suture. Head and thorax densely and finely reticulate and dull, elytra and abdomen strongly shining. Head scarcely narrower than the thorax, front with a few coarse punctures either side, slightly convex medially, transverse occipital groove very strong, a small foveate puncture adherent to it at middle, surrounding surface feebly swollen, clypeal suture distinct, entire and arcuate, antennal tubercles distinct, antennæ scarcely reaching the middle of the thorax, joints three to six elongate, decreasing slightly in length, outer joints scarcely incrassate, as long as wide. Thorax slightly wider than the base of the elytra but narrower than the apex, one fourth wider than long, sides parallel and very slightly arcuate in apical two thirds, strongly narrowed and subsinuate to the rounded and scarcely distinct basal angles, very coarsely and rather closely punctured, punctures separated by less than their own diameters, a median impunctate area anteriorly; median line fine and scarcely impressed anteriorly, coarser and distinctly impressed posteriorly. Elytra one third longer than the thorax,

rather coarsely and closely punctured, subrugose. Abdomen wider than the elytra with a few rather indistinct punctures laterally. Thorax, elytra and abdomen with long, coarse, yellowish pubescence laterally, more abundant on the abdomen. Length 5.5 mm., width 1.25 mm. 1 specimen.

Type 26 May.

This species may be placed in the *annularis* group, having widely open coxal fissures. The fissures are rather short, however, extending a little more than half way to the margin. The sutures are not quite parallel with the margin.

Thinobius amphibius new species.

Form somewhat robust, depressed. Color piceous black, antennae and legs slightly paler, head and abdomen slightly darker. Integuments densely and finely granulate punctate, dull. Head feebly transverse, five sixths the width of the thorax, vertex with a distinct impression. Eyes feebly convex, tempora equally prominent and two thirds their diameter; antennal tuberculations distinct. Antennae long and slender, feebly incrassate, reaching the basal third of the elytra; first, second, third and terminal joints about one half longer than wide, other joints just perceptibly elongate; the terminal suddenly narrowed to a sharp point. Thorax three fifths wider than long, about four fifths the width of the elytra at apex, sides subparallel, distinctly arcuate, posterior angles not distinct, base arcuate, apex slightly emarginate; a small indistinct impression either side at the base. Elytra nearly twice as long as the thorax, conjointly one fourth longer than wide, sides straight, sutural emargination extending to apical third, pubescence extremely fine and dense. Abdomen slightly narrower than the elytra, pubescence coarser, mixed with longer bristles. Length 1.1-1.4 mm., width .3-.35 mm.

Type and 8 paratypes 26 May; 2 paratypes 19 May.

This species may be placed in division II of Casey's synopsis (Col. Not., I, 1880, pp. 78-89). It differs from the three species therein described by its long elytra and very transverse thorax.

Thinobius tardus new species.

This species resembles the preceding very closely but may be distinguished by the following differences. Head slightly less transverse, antennae a little shorter, reaching the basal fourth of the elytra; thorax larger and much less transverse, scarcely one third wider than long, elytra but little more than one third longer than the thorax and slightly less transverse than in the preceding. Length 1.1 mm., width .35 mm.

Type and 2 paratypes 26 May; 1 paratype 19 May.

Thinobius grandicollis new species.

This species is close to the preceding two. It differs by its head distinctly narrower than the thorax, which is proportionally larger and as wide as the elytral humeri. In the two preceding the thorax is perceptibly narrower than the humeri. Thorax one half wider than long, sides and base rounded, basal impressions distinct. Head much more distinctly transverse, fully a third wider than long, antennæ shorter but distinctly longer than the head and thorax, second and third joints about a third longer than wide, outer joints as wide as long, terminal joint subequal to the preceding two. Elytra scarcely perceptibly wider at apex, with the sides straight. Length 1.2 mm., width .4 mm. 1 specimen.

Type 26 May.

Thinophilus caseyi new species.

Form moderately slender, depressed, parallel. Color brownish testaceous, head darker, antennæ, legs and elytra paler, abdomen piceous black; antennæ slightly infusate apically. Head, thorax and elytra densely and finely punctured but somewhat shining. Head slightly transverse, as wide as the thorax, widest at the base where it is truncate and strongly constricted; eyes small, tempora as long as the eyes, posterior angles narrowly rounded. Antennal tuberculations strong, pubescence on head and antennæ long, coarse and abundant, conspicuous. Antennæ long and slender, reaching the middle of the elytra, feebly incrassate distally, first joint stout, cylindrical, nearly three times as long as wide, second shorter, more slender, strongly narrowed basally, three to seven globular, subequal, eight feebly obconic, nine and ten elongate, nearly a third longer than wide, eleven more than twice as long as wide, acutely pointed, not quite as long as the preceding two. Thorax one sixth wider than long, scarcely narrower than the elytra, widest close to the apical margin, sides and base completely and evenly rounded, disk unimpressed. Elytra parallel, one fourth longer than wide and one half longer than the thorax, sides straight. Abdomen as wide as the elytra, sides arcuate, surface evenly alutaceous, somewhat shining, punctures sparse and indistinct. Pubescence on thorax and elytra fine, dense and short, on abdomen coarser and longer with longer bristles intermixed. Length 1.2–1.4 mm., width .3–.4 mm.

Type and four paratypes 26 May.

This species is very distinct by its antennal structure and the proportions of the thorax and elytra.

Thinophilus apicicornis new species.

Form moderately slender, parallel, depressed. Color black, basal joint of the antennæ and elytra slightly picescent, legs brownish testaceous. Head, thorax and elytra punctured as in the preceding, feebly shining. Head scarcely transverse, very slightly wider than the thorax, tempora as long as the diameter of the eyes, parallel, suddenly narrowed to the neck; posterior angles

narrowly rounded; the strong, transverse, basal constriction noted in the preceding, wholly wanting, the neck and the occiput being continuous; front separated from the clypeus by a strongly impressed arcuate line, a distinct median impression on the vertex; antennal tuberculations strong, antennae slightly longer than the head and thorax, about the length of the terminal joint, rather strongly incrassate distally, second joint about one half longer than wide, third slightly elongate, four to eight subglobular, increasing gradually in size, nine and ten larger, ten slightly transverse, terminal joint about one third longer than wide and obtusely rounded at apex, antennae strongly pubescent. Thorax three fifths wider than long, slightly narrower than the elytra, widest at apical third, narrowed anteriorly and posteriorly, posterior angles distinct though rounded, base rounded, apex less rounded, disk with a distinct, longitudinal impression either side extending nearly the length of the thorax, widened basally. Elytra about a fifth longer than wide and nearly twice as long as the thorax, sides straight. Abdomen gradually wider to the apex of the fourth segment, where it is the widest part of the body; four basal segments strongly micro-reticulate, indistinctly and sparsely punctate, moderately shining, fifth segment very strongly shining, reticulation less distinct, four basal segments with an apical row of long, coarse, fulvous hairs which lie flat on the segments, apex of the fifth segment with a very dense fringe of very short, pale, yellowish hairs, broadly and shallowly emarginate, sixth segment deeply emarginate with lateral projections. Length 1.7 mm., width .4 mm. 1 specimen.

Type 21 May.

This species is very distinct in the form of the head and antennae, the impressions of the thorax and the very shining fifth abdominal segment.

***Lathrobium lintneri* new species.**

Form rather slender, parallel, head, thorax and elytra subequal in width, abdomen slightly wider at the apex of the fourth segment; the sexes not differing at all in proportions. Color black, antennae and legs pale piceo-rufous, narrow apical margin of the elytra pale. Head coarsely, deeply and somewhat sparsely punctured, thorax similar in punctuation with a median smooth area equal in width to the length of the fifth antennal joint. Elytral punctuation finer, subasperate and about as sparse. Abdomen densely and finely punctate. Head about as wide as long, sides parallel and arcuate, posterior angles broadly rounded, gular sutures well separated, straight and parallel; antennae slender, not quite reaching the base of the thorax (σ) shorter (φ) joints all distinctly longer than wide and obconic (σ); in the female the tenth joint is about as wide as long; they decrease regularly in length to the tenth, the terminal slightly longer. Thorax one fourth longer than wide, as long as the elytra, sides scarcely arcuate or convergent posteriorly. Elytra with the sides very slightly divergent posteriorly and scarcely arcuate. Posterior tarsi slender,

first joint much shorter than the second, third a little longer than the preceding two. Length 4.75 mm., width .75-1 mm.

Male.—Fifth ventral abdominal segment unmodified, sixth with a feeble median subapical impression and an arcuato-triangular emargination, about one third the width of the segment and nearly as deep as wide.

Female.—Sixth ventral abdominal segment with the apex strongly rounded.

Type ♂ 21 May.

Allotype ♀ 24 May; 2 paratypes ♀ 21 May, 26 May.

This species may be distinguished by its small size, the strong reddish tinge of the antennæ and legs, the punctuation of the head and thorax and the proportions of the thorax and elytra.

Scopæoma pallida new species.

Form rather slender and parallel, slightly convex. Color uniform, rather pale rufo-testaceous; very finely and densely punctured throughout, lustre dull. Head quadrate, as long as wide, very slightly wider than the thorax, sides subparallel, slightly arcuate, base truncate, posterior angles rounded, eyes small, tempora nearly four times their diameters; labrum with two long, slender, very acute, median teeth, a slight emargination between them, outer teeth not apparent; antennæ slender, nearly one half the length of the body; mandibles with three stout basal teeth; gular sutures close together and parallel; neck about one sixth the width of the head. Thorax elongate oval, one third longer than wide, widest at apical third, anterior angles completely rounded, a very narrow median smooth line, a distinct longitudinal impression either side in basal half. Elytra one fourth longer than wide, parallel, very slightly wider than the thorax, equal in width to the head. Abdomen at the apex of the fourth segment just perceptibly the widest part of the body. Posterior tarsi short, four basal joints subequal in length, anterior tarsi dilated. Length 3.75-4 mm., width .5-.75 mm.

Male.—Second, third and fourth ventral segments with a median apical swollen area, that on the fourth extending nearly to the base and carinate apically; fifth very broadly and shallowly emarginate, a minute nick in the margin at the apex of the emargination, a fine and entire median carina, sixth with an acutely triangular emargination, longer than wide, extending beyond the middle of the segment and about one fourth the width of the segment, no modification anterior thereto.

Type 19 May.

Allotype and 1 paratype 19 May.

This species may be placed with *S. truncaticeps* Csy. which is described as black, shining with red brown legs and antennæ, and having the head slightly wider at the basal angles.

Gyrophypnus pallipennis new species.

Form elongate, slender, moderately convex, shining. Color dull testaceous, thorax rufo-testaceous, head black, apex of the abdomen infusate, antennæ rufous. Head elongate, widest at base, behind the front margin of the eyes distinctly longer than wide, sides nearly straight, basal angles broadly rounded, frontal grooves strong, gular sutures distinct and very approximate behind the middle; antennæ with the second and third joints slightly elongate, subequal. Head coarsely and rather sparsely punctured with a median smooth area, genæ shining with the strigillation rather feeble, a few coarse and somewhat indistinct punctures. Thorax slightly narrower than the head, two fifths longer than wide, distinctly narrower to the base, punctures in discal rows 9-12 in number, lateral groups with twelve, elytra as wide as the head and as long as the thorax with four discal rows of rather fine and indistinct punctures. Abdomen very minutely and finely punctate and strigillate. Length 5 mm., width .75 mm.

Type 19 May.

This species resembles very closely a specimen listed as *G. fusciceps* Lec. Aside from the difference in the number of punctures in the thoracic series, it differs in the head more elongate with the sides straighter, in the thorax narrower than the head (as wide as the head in *fusciceps*) and more strongly narrowed behind.

Leptusa (Ulitusa) laticollis new species.

Form elongate, parallel, slightly convex. Color dark reddish piceous, head and apical segments of abdomen blackish, antennæ and legs dull rufous; punctures large, shallow, dense, umbilico-asperate, those on the elytra coarser, strongly asperate, confluent and rugulose, punctures on the abdomen coarse and asperate but moderately separated, abdomen more shining, particularly the apical segments; pubescence pale, moderate, not very conspicuous. Head transverse, four fifths the width of the thorax, tempora as long as the eye, somewhat convergent, scarcely arcuate, infralateral carinæ strong, entire, the terminal joint of the labial palpi is long, slender, narrowed basally and truncate at apex, the ligula is slender, parallel and entire at apex, the mentum and submentum are rugose; antennæ reaching the base of the thorax, strongly incrassate, second and third joints, elongate, of equal length, fourth scarcely as wide as long, ninth and tenth three fourths wider than long, terminal joint as long as the two preceding, arcuato-conical. Thorax three fourths wider than long, as wide as the elytra, widest at apical third, narrowed anteriorly, oblique and sinuate posteriorly, posterior angles small but sharp and prominent, disk just visibly impressed medially and transversely at the base. Elytra just perceptibly transverse, parallel, two thirds longer than the thorax. Abdomen slightly narrower, subparallel, three basal segments strongly transversely impressed at base. Intermediate coxæ rather narrowly separated, the sternal projections

contiguous at the middle, the mesosternal more slender, both projections very strongly margined, that of the metasternal rounding some distance posterior to the apex; the mesosternum strongly compresso-carinate medially in the basal two thirds. Posterior tarsi nearly three fourths the length of the tibiae, four basal joints equal. Length 1.9–2.1 mm., width .4–.5 mm.

Male.—Fifth dorsal segment with a rather broad and obtuse but strongly elevated median carina, not quite reaching the apical margin and about two thirds the length of the segment.

Type ♂ and allotype ♀ 19 May.

This species seems to differ materially in color, form and sculpture from *L. cribratula* Csy. and *L. pusio* Csy.

***Tinotus lateralis* new species.**

Form stout, fusiform, convex, moderately shining. Color dull rufo-testaceous. Head and the fourth and fifth segments of the abdomen black, the elytra broadly infusate laterally, sutural margin finely blackish; three basal antennal joints pale, outer joints blackish piceous. Head, thorax and elytra micro-reticulate, head more shining, punctures fine throughout, those on the head finer and sparser, those on the thorax closer, those on the elytra no coarser than those on the thorax but as sparse as those on the head and more distinctly asperate. Abdomen without reticulation but with long bilineiform scratches. Punctures on the anterior parts umbilicate. Head transverse when inserted, three fifths as wide as the thorax, sides parallel, eyes at less than their own length from the base, antennae reaching the base of the thorax, second and third joints equal, elongate, fourth joint as long as wide, ninth and tenth joints twice as wide as long, terminal joint as long as the three preceding. Thorax three fifths wider than long, sides arcuate, strongly narrowed anteriorly, parallel posteriorly, base rounded, disk very convex, without trace of median impression though the pubescence is arranged with a distinct parting along the median line. Elytra as wide as the thorax, sides parallel, suture as long as the thorax, suture slightly impressed. Abdomen slightly narrower than the elytra, sides evenly arcuately narrowed, margins moderately thick. Basal joint of the hind tarsi equal in length to the next two. Length 1.75 mm., width .5 mm.

Type 28 May.

The striking coloration of this species together with the form of the antennae, sculpture of the anterior parts and proportions of the thorax and elytra distinguish it from those hitherto described.

***Trichiusa transversa* Csy.**

Four specimens of this species were collected under the bark of a decayed log in a colony of the ant *Ponera coarctata*, subsp. *pennsylvanica* Buckley. Stray specimens of the ant *Aphanogaster*

fulva, subsp. *aquia* Buckley were also present. The ants were kindly identified for the writer by Dr. J. Bequaert.

Genus **Amphibitherion** new genus.

Head slightly transverse, eyes large, infralateral carinae fine and entire; antennae long and slender, second and third joints equal, not much longer than the fourth which is elongate, tenth joint not transverse. Mouth parts as in the genus *Atheta*.

Thorax and elytra moderately transverse.

Abdomen subparallel, fifth segment not narrower. Dorsal segments uniformly, almost coarsely and somewhat closely punctured, fourth and fifth not more shining, punctuation much more distinct than that of the anterior parts.

Intermediate coxae distinctly though narrowly separated; sternal projections contiguous at their middle; metasternal projection with its upper surface evenly convex, but inclined slightly anteriorly so as to pass beneath the point of the mesosternal projection, anterior marginal line of the metasternum very feebly rounded between the coxae.

Four basal joints of the posterior tarsi slightly elongate, of subequal length.

The distinctly separated intermediate coxae, the long, slender antennae with the second and third joints of equal length and the uniformly punctured abdomen distinguish this genus from *Metaxia*, *Traumacia* and *Atheta*, to all of which genera it is closely related.

Amphibitherion demissum new species.

Form rather slender, subdepressed, parallel. Color black, antennae and thorax blackish piceous, the former not paler basally, elytra and legs paler. Integuments extremely finely micro-reticulate; punctures on the head sparse and indistinct, on thorax and elytra close but indistinct, on abdomen rather coarse and close; pubescence on thorax and elytra fine and dense, fulvo-cinereous. Head slightly transverse, scarcely narrower than the thorax, eyes large, tempora parallel, scarcely two thirds the length of the eye, vertex with a shallow impression, antennae surpassing the base of the thorax, scarcely at all incrassate, second and third joints about one half longer than wide, fourth joint elongate, a little shorter than the third, five to seven very slightly elongate, eight to ten as long as wide, terminal joint long, parallel, as long as the two preceding. Thorax nearly a third wider than long, about four fifths the width of the elytra, widest slightly before the middle, sides feebly arcuate, disk

with a distinct median impression before the scutellum. Elytra parallel, about one fourth wider than long and one fourth longer than the thorax. Abdomen slightly narrower than the elytra with the three basal, dorsal segments distinctly impressed basally, fifth segment slightly longer than the fourth. Length 1.75-2.15 mm., width .4-.55 mm. Four specimens showing no sexual differences.

Type 22 May; 3 paratypes 19, 22, 23 May.

This species is close to *A. (Philhygra) palustris* Kiesw. It differs by the second and third antennal joints equal and the outer joints more or less elongate and not incrassate, by the less transverse thorax and the strongly punctured fourth and fifth dorsal segments of the abdomen.

Hydrosmeeta torrida new species.

Form elongate, parallel, rather depressed. Color, head and abdomen blackish, thorax and elytra flavo-piceous, antennæ and legs rather pale piceo-testaceous. Integuments finely microreticulate, moderately shining, abdomen more shining, punctures fine but not dense, pubescence moderately long and rather conspicuous. Head transverse, eyes rather small, at about their own diameters from the base, tempora slightly swollen and more prominent than the eyes, infralateral carinæ fine, abbreviated in front; antennæ rather short, not incrassate, reaching the base of the thorax, second joint long, nearly twice the length of the third which is very slightly elongate, outer joints not or scarcely elongate, terminal joint as long as the two preceding. Thorax as wide as the head, scarcely narrower than the elytra, nearly one third wider than long, sides subparallel and scarcely arcuate, disk with a feeble median impression. Elytra as long as wide, parallel. Abdomen slightly narrower. Length 1.8 mm., width .4 mm.

Type 26 May.

This species is slightly larger than *H. caduca* Csy., with shorter antennæ, much longer cephalic carinæ and a more transverse thorax.

Hydrosmeeta tinctoria new species.

Form elongate, parallel, rather depressed. Color, head and abdomen black, thorax, antennæ and legs pale flavo-testaceous, elytra darker, piceous. Integuments as in the preceding. Head slightly transverse, as wide as the thorax, eyes somewhat smaller, tempora more swollen and prominent, slightly longer than the diameter of the eyes, infralateral carinæ fine, abbreviated in front; antennæ long and rather thicker but not incrassate, reaching to the middle of the elytra, second joint elongate, much longer than the third which is slightly elongate, outer joints not at all longer than wide, terminal joint as long as the two preceding. Thorax a third wider than long, sides subparallel, scarcely

arcuate, disk with a feeble median impression. Elytra as long as wide and about a third longer than the thorax, sides parallel. Abdomen not narrower. Fifth segment longer than the fourth. Length 1.8 mm., width .4 mm.

Type 19 May.

This species is distinct from the preceding by its much longer antennæ and pale thorax. It is distinct from *H. caduca* Csy. by its larger size, slightly thicker antennæ, with the outer joints not elongate, longer cephalic carinæ and more transverse thorax.

***Thiasophila parvula* new species.**

Form stout, convex, subfusiform. Color black, antennæ and elytra feebly picescent, legs and two basal joints of the antennæ paler. Head, thorax and elytra densely and finely micro-reticulate and dull, punctures of moderate size and rather dense, asperate on the thorax and elytra, strongly so on the latter, abdomen shining, reticulation feeble, punctures sparser, but asperate, pubescence moderate, fulvo-cinereous, more conspicuous on the abdomen. Head suborbicular, slightly more than half the width of the thorax, eyes large, at scarcely more than half their diameters from the base, carinæ strong, entire, antennæ short, scarcely reaching the base of the thorax, incrassate, second joint shorter than the first, scarcely shorter than the third, fourth as long as wide, five to ten strongly transverse, tenth joint about three fourths wider than long, terminal joint elongate-oval, with a strongly marked annulation. Thorax three fifths wider than long, slightly wider than the base of the elytra, about as wide as the widest part, widest at the middle, sides parallel and nearly straight posteriorly, distinctly convergent and feebly arcuate anteriorly, base broadly rounded and subsinuate laterally, posterior angles very narrowly rounded, disk strongly convex, with a distinct antescutellar impression. Elytra conjointly about two fifths wider than long, suture as long as the thorax, apical sinuses not distinct. Abdomen slightly narrower than the elytra and feebly attenuate posteriorly. Intermediate coxæ moderately separated, mesosternal projection long, extending to apical fourth of the coxal length, rather attenuate and overlapping the broadly triangular metasternal projection; mesosternum not carinate. Basal joint of the posterior tarsi elongate, but much shorter than the last joint, not as long as the second and third together. Length 3 mm., width .75 mm.

Male.—Apex of the sixth dorsal segment with eight broad triangular teeth.

Female.—Unmodified.

Type 24 May; allotype Windsor, N. Y., 5 June, 1918 (erroneously listed as *Oxyptoda obliqua* Csy. in the writer's list of Coleoptera collected at Windsor. JOURN. N. Y. ENT. SOC., XXVIII, p. 181).

2 paratypes ♂ ♀ Keene Valley, Essex Co., N. Y., 3, 18 June, 1915.

This species is distinguished by its small size, dark color and short, stout antennæ. Ganglbauer states that the ligula is divided

to the middle in this genus. In one of the specimens the ligula is plainly visible. It is long, narrow and undivided. The ligula is exactly similar in a specimen of the European *T. angulata* Er. which agrees in other respects with Ganglbauer's description of that species. It is possible, therefore, that the generic characterization may be erroneous in this respect. Otherwise the species agrees well with the description of *Thiasophila*.

Ptenidium simplicicollae new species.

Form short, robust, very convex. Color black, elytra pale apically from diaphaneity, antennæ and legs bright rufo-testaceous. Integuments very strongly shining, completely impunctate and glabrous. Head nearly twice as wide as long, eyes large, very convex, head three fifths the width of the thorax, antennæ reaching the base of the thorax. Thorax three fifths wider than long, very slightly narrower than the elytra, apex a little narrower than the elytra, apex a little narrower than the base, widest a little before the middle, sides more arcuate and convergent anteriorly, oblique and nearly straight posteriorly, disk very convex, entirely devoid of basal impressions. Scutellum with a crenulate basal margin. Elytra evenly oval, one fourth longer than wide, slightly more than twice as long as the thorax, as wide as the thorax at base, humeri not exposed, widest at basal third, base with a finely beaded margin. Legs somewhat robust. Length .9 mm., width .5 mm.

Type 26 May.

This species is distinct by the complete absence of thoracic foveæ, moderately transverse thorax, short elytra and the entirely glabrous and impunctate integuments.

Atomaria parviceps new species.

Form very elongate, subparallel, convex, shining. Color uniform, rather pale ferruginous. Head, thorax and elytra at base somewhat coarsely and moderately closely punctured, punctuation becoming indistinct apically on the elytra; thoracic hypomera coarsely punctate anteriorly, metasternum, metepisterna and elytral epipleuræ coarsely and somewhat closely punctured, pubescence moderately coarse and dense, inclined. Head rather small, not more than three fifths the width of the thorax, antennæ scarcely surpassing the base of the thorax, first joint short and stout, scarcely as long as the next two, four, six and eight small, globular, five slightly elongate, club strong, nine and ten distinctly transverse. Thorax one third wider than long, about five sixths the width of the elytra, widest at basal one fourth, strongly narrowed and arcuate to base, gradually and feebly arcuately but distinctly more narrowed apically, apex distinctly narrower than the base, base narrowly impressed along the margin. Elytra at the humeri very slightly wider than the thorax, three

fourths longer than wide, sides subparallel and rounded in at slightly more than apical third, humeri minutely dentate. Prosternum not carinate. Length 2.1 mm., width .8 mm.

Type 26 May.

This species belongs in the genus *Agathengis* of Casey's synopsis. It should probably be placed next to *patens* Csy. but differs in its color, small head and elytra proportionally narrower.

Hypnoidus felti new species.

Form moderately elongate, parallel, slightly convex and shining. Color piceous brown, elytra with a broad blackish fascia behind the middle, antennae and legs pale testaceous. Head rather finely, indistinctly and not closely punctured. Thorax more closely and distinctly punctured with a narrow smooth median line. Elytra with the striation obsolete, punctuation not quite so close or distinct as that on the thorax; beneath finely and closely punctate, pubescence very short, fine and somewhat dense. Head rather small, slightly more than half the width of the thorax, antennae short, slender, not reaching the base of the thorax, second and third joints of equal length, elongate and cylindrical. Thorax a little more than a fourth wider than long, widest near basal third where it is as wide as the elytra, rather strongly narrowed anteriorly, sides nearly straight, slightly oblique and subsinuate posteriorly, posterior angles minutely prominent and divaricate, carinate, carinae rather distant from and parallel to the side margin to near the base where they are sharply angulate. Prosternal sutures arcuate and distinctly convergent basally. Elytra two thirds longer than wide, sides parallel to the apical third, apex somewhat acutely rounded. The fifth segment of the abdomen is narrowly and sharply declivous along the apical margin and prolonged on either side. Length 2.9 mm., width .75 mm. 1 specimen.

Type 26 May.

This species may be distinguished from *H. pectoralis* Say by its slightly broader form, smaller head, thorax widest some distance behind the middle and by the sharply angulated carinae of the posterior thoracic angles.

Elater longipennis new species.

Form elongate, subparallel, slightly convex. Color black, elytra with a red spot either side of the scutellum, an obscure reddish spot either side beneath the humerus, antennae and tarsi picescent. Head coarsely and closely punctured, thorax similarly punctured anteriorly and laterally, more sparsely and finely medially and posteriorly, pubescence fulvous, moderately coarse and dense. Head about one half the width of the thorax, antennae slightly surpassing the base of the latter, second and third joints short, subequal, third much shorter than the fourth, not triangular, outer joints moderately serrate,

longer than wide. Thorax as long as wide, sides gradually narrowed and nearly straight before the middle, subparallel and distinctly sinuate posteriorly, posterior angles distinctly divaricate and unicarinate. Elytra not wider than the thorax, about three times the length, sides subparallel, becoming gradually attenuate behind the middle, striæ deep, distinctly punctate, intervals rather feebly convex, rather finely, sparsely and asperately punctured. Length 9.25 mm., width 2.5 mm.

Type 26 May.

This species is related to *E. nigrinus* Hrbst. Aside from the color differences it may be distinguished by the thorax gradually narrowed before the middle and distinctly sinuate posteriorly and by the longer elytra.

NEW SPECIES OF SERICA (SCARABÆIDÆ). IV.

BY R. W. DAWSON,

LINCOLN, NEBRASKA.

Serica lecontei new species.

♂. Length 9.5 mm., width 5 mm. Color varying from pale to very dark chestnut, surface polished and shining.

Clypeus nearly level with the plane of the front, sometimes slightly depressed, especially toward the sides; lower median portion feebly tumid; anterior margin moderately but suddenly reflexed, lateral margins less strongly and suddenly elevated; lateral incisure narrow and acute extending about two thirds of the depth of the elevated margin. Clypeus rather strongly and closely punctured, the punctures larger and separated by about their own diameters near the suture, smaller and more closely placed on the slightly tumid area just below the middle. Clypeal suture fine but distinct and unmodified. Front less closely and regularly punctured than the clypeus. Antennal club rather large, about equalling the total length of the antenna. Eyes of usual size. Measurements of head (in tenths of a millimeter) as follows: diameter of head through eyes, 25; distance between inner eye margins, 14; length of head on median line, 13; extreme width of clypeus in front of the incisure, 12; antennal club, 10.5; dorso-ventral diameter of eye, 9.4.

Pronotum moderately convex, the sides but little rounded, gradually convergent from the posterior angles to the anterior third, then more strongly rounded to the anterior angles; posterior angles obtuse but prominent and well marked, sides distinctly margined; puncturation rather strong and evenly distributed, the punctures separated by one to two times their own diameters. Measurements of pronotum as follows: width through posterior angles, 41;

width through anterior angles, 26; length on median line, 22. Scutellum closely and strongly punctured; length, 9.5; width, 10.

Elytra rather strongly furrowed, the sulci with three very much confused rows of coarse, closely placed punctures, the costae well rounded and with a few scattered punctures, especially on the second, fourth and sixth; length, 75; width, 50.

Metasternum and posterior coxal plates rather strongly and closely punctured, the puncturation usually denser toward the sides. Abdominal sternites with rather numerous but finer punctures, the single rows of coarse punctures bearing the ambulatorial setae well marked, but the setae small and inconspicuous. Fourth sternite usually with a distinct, median, longitudinal impression near which the punctures show a tendency to develop into longitudinal wrinkles or little grooves; these modifications well marked to nearly obsolete. Last sternite opaque.

Genital armature of male (Pl. IX) symmetrical, length 2.4 mm.

♀. Differs from the male in the much smaller antennal club (5 instead of 10.5), the much less developed or obsolete clypeal notch, and the more convex, and unmodified abdominal sternites.

Type: ♂. Currant Cheap's, Charlottesville, Virginia, April 22, 1914 (H. Fox).

Allotype: ♀. Charlottesville, Virginia, May 25, 1914 (H. Fox), on red oak.

Paratypes: 136 ♂, 95 ♀.

Maine: Paris, 1 ♂, 2 ♀; Monmouth, 1 ♂; Ogonquit, 1 ♂; Old Orchard, 2 ♂.

New Hampshire: Durham, 1 ♂; E. Wakefield, 1 ♂; Three Mile Island, 3 ♂, 6 ♀; Hooksett, 1 ♀.

Vermont: Bennington County, 1 ♂.

Massachusetts: "Mass.," 3 ♂, 2 ♀; Boston, 4 ♂, 1 ♀; Fairhaven, 1 ♂; Southboro, 1 ♀; Berlin, 1 ♀; Hopkinton, 2 ♂, 2 ♀; Marion, 1 ♂; Natick, 2 ♂, 1 ♀; Stoneham, 8 ♂; Sherborn, 1 ♂, 6 ♀; Framingham, 17 ♂, 7 ♀; Tyngsboro, 18 ♂, 9 ♀; Dracut, 1 ♀; Essex County, 1 ♀; Danvers, 2 ♂.

Rhode Island: "R. I.," 1 ♂.

Connecticut: Cornwall, 1 ♂; New Haven, 3 ♂; Stanford, 1 ♂.

New York: "N. Y.," 1 ♂; Peru, 1 ♂; Wilton, 3 ♂, 6 ♀; Ithaca, 13 ♂, 3 ♀; Staten Island, 1 ♂, 1 ♀.

Pennsylvania: Hummelstown, 1 ♀; Gettysburg, 1 ♀; Hecton Mills, 1 ♂; Carlisle Junction, 1 ♀; Rockville, 1 ♀.

New Jersey: "N. J.," 1 ♂; Bergen County, 13 ♂, 18 ♀; Lahaway, Ocean County, 1 ♀; Fort Lee District, 1 ♀; Ridgewood, 1 ♂; Phillipsburg, 1 ♀; Brown's Mills Junction, 1 ♀.

Maryland: "Md.," 1 ♂.

Delaware: "Del.," 2 ♂.

Virginia: Charlottesville, 3 ♂, 3 ♀.

Illinois: Chicago, 1 ♂.

Michigan: Biological Station, 1 ♂; Isle Royal, Lake Superior, 1 ♀;

Douglas Lake, 3 ♂, 4 ♀.

Wisconsin: "Wisc.," 1 ♂; Bayfield, 1 ♂, 1 ♀.

North Carolina: Chapel Hill, 1 ♀; Southern Pines, 5 ♂, 1 ♀.

Georgia: Gainesville, 1 ♂, 1 ♀.

Alabama: Tumbling Gap, 2 ♂, 2 ♀.

Canada: Toronto, Ontario, 1 ♀; Ottawa, Ontario, 2 ♂; Three Rivers,

Quebec, 1 ♂; Nova Scotia, 2 ♂, 3 ♀.

The material studied seems to indicate a definite correlation between the intensity of certain characters and the geographical distribution of the species. Northern specimens average larger, sometimes reaching ten millimeters in length, while southern specimens are smaller, usually measuring less than nine millimeters, and sometimes down to seven. Southern specimens also seem to average lighter in color, frequently being pale chestnut or testaceous. Accompanying the reduction in size and color intensity occurs some modification of the male genital armature. The characteristic sudden and strong inflation of the stalk of the armature seems to become progressively less well marked, until in the Alabama specimens the stalk is but little modified. The specimens from Southern Pines, North Carolina and Gainesville, Georgia, show a moderate amount of expansion or widening of the terminal portion of the claspers.

Among the previously described species *lecontei* is most closely related to *georgiana* Leng, but the latter species may be recognized at once by its very strongly tumid clypeus. The genital armatures of the two species are very similar, but the stalk of the armature in *georgiana* is never so strongly and suddenly enlarged as in typical *lecontei*.

***Serica spicula* new species.**

♂. Length 7.5 mm., width 4.5 mm. Color claret brown to chestnut, surface bare, polished and shining.

Clypeus not, or but very slightly, depressed, the discal area below the center with a distinct median tumidity, nearly as prominent, when viewed from the side, as the reflexed anterior margin. Anterior margin abruptly, moderately elevated, divided from the less strongly and suddenly elevated lateral margins by deep and acute incisures. Viewed perpendicularly the anterior, reflexed margin broadly and feebly emarginate medially, viewed at an angle from above, evenly but very slightly arcuate. Clypeal suture nearly arcuate,

fine and inconspicuous. Punctures of clypeus moderately fine and quite regularly placed, separated by about their own diameters. Front less closely and regularly punctured than the clypeus, especially in the upper portion where it becomes nearly impunctate. Antennal club well developed, slightly longer than the preceding joints. Eyes moderately prominent. Measurements of head in tenths of a millimeter: diameter of head through eyes, 22; distance between inner eye margins, 13; length of head on median line, 17; extreme width of clypeus in front of incisure, 10; antennal club, 9.4; dorso-ventral diameter of eye, 8.

Pronotum not very convex, the sides only feebly arcuate, hind angles distinct, nearly rectangular, surface very uniformly punctured, with the punctures slightly coarser than those of the head, and separated by one to two times their own diameters; at the middle of each side, near the margin a small, inconspicuous, piceous spot. Measurements of pronotum: width through posterior angles, 35; width through anterior angles, 23; length on median line, 20. Scutellum with moderate-sized punctures crowded toward the sides; length, 9.4; width, 9.4.

Elytra rather strongly furrowed, the sulci with two confused rows of rather strong punctures, separated by about half their own diameters, costæ well rounded and polished, with only an occasional strong puncture; length, 60; width, 45.

Metasternum and posterior coxal plates strongly and coarsely punctured, the punctures separated on the average by a little less than their own diameters. Hind femora and abdominal sternites also closely and deeply punctured but the punctures distinctly smaller than those of the hind coxal plates, separated on the last sternite, which is more or less strongly opaque or pollenose, by half their own diameter or less. The single rows of ambulatorial setæ and the coarse punctures bearing them not at all conspicuous.

The genital armature of the male (Pl. X) bears a striking resemblance to that of *lecontei*, but differs at a glance by possessing the terminal spicules; length, 2.3 mm.

♀. Differs from the male by its smaller antennal club (6.5 instead of 9.4), less strongly developed clypeal incisure, more convex underline of abdomen and arcuate, rather than emarginate, terminal sternite.

Type: ♂. Macon, Georgia, May 6, 1919 (Fox and Johnson), on post oak.

Allotype: ♀. Same data.

Paratypes: 1 ♂, 1 ♀. Same data.

***Serica opposita* new species.**

♂. Almost an exact counterpart of *spicula* just described, but differing as follows: averaging slightly larger, length 8 mm., width 4.7 mm.; clypeal tumidity less well developed, viewed in profile scarcely half the height of the anterior reflexed margin; clypeal incisures stronger and less acute, entirely dividing the somewhat more strongly elevated lateral and apical reflexed mar-

gins, the apical, reflexed margin almost straight when viewed perpendicularly; antennal club relatively larger, 11 instead of 9.4; the claspers of the genital armature of male (Pl. XI) lack the terminal spicules, but show on each side a well-developed median tooth.

♀. Clypeal margins, especially the lateral, only half to two thirds as strongly elevated as in the male, and clypeal notch distinctly less well developed, acute and on the average about half dividing the elevated rim; antennal club small, 7.6 instead of 11 as in the male.

Type: ♂. Riverton, New Jersey, May 25, 1919 (J. J. Davis), on post oak.

Allotype: ♀. Same data.

Paratypes: 11 ♂, 12 ♀.

New Jersey: "N. J.," 6 ♂, 3 ♀; Riverton, 5 ♂, 9 ♀.

Serica vespertina accola new subspecies.

♂. Length 8.5 mm., width 4.8 mm. Color uniformly light brown (amber brown to argus brown), surface bare, polished and shining.

Clypeus not or but very little depressed at the suture, nearly flat with only a very feeble convexity beyond the middle; anterior margin abruptly, moderately elevated, separated from the slightly less elevated lateral margins by strong though acute incisures which nearly or quite divide the elevated rim. Viewed vertically the anterior reflexed margin is straight, viewed at an angle from above rather strongly and evenly arcuate from side to side. Clypeal suture distinct, bluntly angled at the middle. Puncturation close, even, and moderately strong, the punctures separated by one half to two thirds their own diameters. Front less closely and regularly punctured, especially above. Antennal club about equal to the total length of the antenna beyond the basal constriction of the first segment. Eyes larger than usual. Measurements of head: diameter of head through eyes, 25; distance between inner eye margins, 13.5; length of head on median line, 18; extreme width of clypeus in front of incisure, 11.5; antennal club, 9.4; dorso-ventral diameter of eye, 10.

Pronotum less convex and narrower behind than usual, sides feebly arcuate, moderately convergent through the anterior third; surface covered with moderate-sized punctures, rather evenly placed, separated by one to two times their own diameters, except just above the mid-lateral piceous spot where the punctures are a little smaller and separated by only half their own diameter, while below and behind this area the punctures are less numerous, but twice as large. Measurements of pronotum: width through posterior angles, 38; width through anterior angles, 26; length of median line, 22. Scutellum strongly and closely punctured, except at the middle, length, 7.7; width, 7.7.

Elytra only moderately furrowed, the sulci with three fairly definite rows of strong punctures, separated by about their own diameter; the costæ with only an occasional coarse puncture, well rounded but somewhat narrowed and rather definitely marked by the adjoining rows of strong punctures; length, 65; width, 48.

Mesosternum and posterior coxal plates strongly and coarsely punctured, more closely so toward the sides where the punctures are separated by only half their own diameter. Punctures of abdominal sternites distinctly smaller, half to two thirds the size of those on the posterior coxal plates, and separated by nearly twice their own diameter. The single rows of ambulatorial setae short and inconspicuous, born by only moderately coarse punctures. Fourth sternite with a more or less well-defined, median, longitudinal impression, with the adjacent punctures often tending to develop into longitudinal wrinkles. Last sternite and margins of pygidium opaque and faintly iridescent.

Length of genital armature of male (Pl. XII), 3 mm. A very characteristic position of the claspers shows the shorter one more strongly flexed downward than the longer one.

♀. Differs from the male by having distinctly smaller eyes (8.2 instead of 10), shorter antennal club (8 instead of 9.4) and the fourth abdominal sternite unmodified.

Type: ♂. Lincoln, Nebraska.

Allotype: ♀. South Bend, Nebraska, May 5, 1918 (R. W. Dawson), on boxelder.

Paratypes: 8 ♂, 9 ♀.

Nebraska: Lincoln, 3 ♂, 6 ♀; West Point, 1 ♀.

Alabama: Mobile, 4 ♂, 1 ♀; Grand Bay, 1 ♂, 1 ♀.

The form here described differs from *vespertina* principally in the form of the clypeus, which in that species is strongly, transversely ridged or folded, or as the original description says: "*in medio disci transversim elevato-sub-carinatus.*" The transverse ridge is very densely punctured. However, these very striking and positive characters vary in intensity and seem to be evanescent, especially in the southern and western parts of the range of *vespertina*. Since the genital armatures of *vespertina* and *accola* are indistinguishable it seems best to regard *accola* as a geographical race or subspecies of *vespertina*.

Serica egregia new species.

♂. Length 8 mm., width 4.2 mm. Color chestnut, surface opaque, slightly sericeous, probably distinctly so on fresh specimens.

Clypeus feebly and indistinctly tumid beyond the middle of the discal area, anterior margin moderately reflexed, lateral margins less strongly elevated, especially toward the clypeal suture; viewed vertically, the anterior margin broadly and distinctly arcuate at the middle, with the corners less broadly rounded than in *mixta*; viewed at an angle from above, the margin appears slightly bisinuate because of the rather prominent rounded corners; lateral incisure entirely obliterated; clypeus densely, evenly and finely punc-

tured, the punctures separated by little more than half their own diameters. Clypeal suture arcuate and distinct. Front less densely punctured than the clypeus, the punctures separated by about twice their own diameters. Antennal club small, about equal to the combined length of joints 2-6, inclusive. Eyes relatively small. Measurements of head in tenths of a millimeter: diameter of head through eyes, 21; distance between inner eye margins, 15; length of head on median line, 16.5; antennal club, 6; dorso-ventral diameter of eye, 6.5.

Pronotum not very convex, the punctures fine, rather evenly placed and separated by about twice their own diameters; posterior angles of pronotum well rounded but distinct, lateral margins only slightly arcuate, the mid-lateral, pigmented spot present. Measurements of pronotum: width through posterior angles, 33; width through anterior angles, 22; length on median line, 19. Scutellum evenly punctured like the pronotum: length, 6.5; width, 7.

Elytra with distinct line-like striae, each stria with a single, slightly irregular row of fine punctures separated by about their own diameters; the rows of punctures somewhat obscured or confused by rather numerous, fine punctures at the sides of the intervals. The lateral striae at least with a few yellow, semi-erect, but inconspicuous hairs. The intervals of uniform width instead of alternately wider and narrower as in *mixta*. Length of elytra, 60; width, 43.

Under surface shining, but with a slight metallic sheen or iridescence. Metasternum and posterior coxal plates strongly punctured, the punctures separated by one to three times their own diameters. Abdominal sternites with the usual single rows of coarse, setigerous punctures and with a fine puncturation about like that on the pronotum, except on the last sternite where the puncturation becomes a little coarser, stronger and denser with the punctures showing a tendency to coalesce. Under surface, except in the region of the anterior coxae and mesosternum, nearly devoid of hair, the pubescence yellow, very fine, sparse and inconspicuous.

Length of genital armature of male, 2 mm. (Pl. XIII).

♀. Unknown.

Type: ♂. California.

The unique type of this species is the fourth of the five specimens associated together under the name *mixta* by Dr. Le Conte. The specimen, of course remains in the Le Conte collection.

It seems to the writer not improbable that the two species here described as new (*egregia* and *abdita*) were only tentatively associated by Dr. Le Conte with the first three type specimens of *mixta*.

***Serica abdita* new species.**

♂. Length 7 mm., width 3.75 mm. Color brownish testaceous (argus brown), surface not polished as in the *vespertina*-like species, but somewhat opaque or pollenose with more or less of a sericeous, iridescent luster, the exact intensity of which cannot be determined from the single specimen at hand.

Clypeus with the discal area practically continuous with the slight, even convexity of the front, its margins rather strongly elevated, scarcely less so at the sides which are not separated from the apical portion by an incisure, there being a scarcely discernible waver in the elevated margin at the juncture of its apical and lateral parts; viewed perpendicularly the anterior margin is straight, viewed at an angle from above a slight median prominence is evident; surface of clypeus finely, evenly, and closely punctured, the punctures separated by about half their own diameters. Clypeal suture very fine and indistinct. Front a little less strongly, closely and evenly punctured than the clypeus. Antennal club of moderate size about equal to the total length of the antenna beyond the basal constriction of the first segment. Eyes relatively small. Measurements of head in tenths of a millimeter: diameter of head through eyes, 19; distance between inner eye margins, 13; length of head on median line, 15; antennal club, 7.5; dorso-ventral diameter of eye, 6.

Pronotum moderately and evenly convex, the surface finely, closely and evenly punctured, the punctures separated by about their own diameters, slightly more at the middle and less at the sides; posterior angles rather obtuse and rounded, anterior angles distinct; width of pronotum, viewed vertically, carried forward to the middle, then distinctly decreasing to the anterior angles; lateral margins, viewed from the side, rather strongly and evenly arcuate from base to apex; near the lateral margins and about three fifths of the way from the base a small, slightly impressed area with a small, pigmented spot on its posterior margin. Measurements of pronotum as follows: width through posterior angles, 30; width through anterior angles, 20; length on median line, 18. Scutellum finely and densely punctured except for a small median and basal area; length, 7; width, 8.

Elytra with rather feebly impressed, line-like striae, each stria with a single row of small punctures, separated by a little more than their own diameters, the rows of punctures, however, somewhat confused or obscured by admixture with the sparse, scattered punctures of the intervals. The intervals feebly convex, the second, fourth, sixth and eighth very slightly wider than the others. Length of elytra, 53; width, 37.

Metasternum and posterior coxal plates, especially the latter, shining and polished, elsewhere, except the femora, tibiae and tarsi, with the surface dulled by a sericeous bloom. Beneath, except on the abdomen, thinly clothed with erect, yellow hairs, the hairs on the metasternum comparatively short, about half the length of those on the anterior and middle coxae and femora. Punctuation fine and close on the metasternum, distinctly stronger and a little less dense on the posterior coxal plates, and very fine or minute on the abdomen, where the punctures bear short, inconspicuous, recumbent hairs. The usual, single rows of coarse setigerous punctures well developed on the abdominal sternites.

Length of genital armature of male, 2.7 mm. (Pl. XIV). Attention should be drawn to an important structural feature not clearly shown in the figures,

namely, the presence of a narrow, tapering, chitinous process extending far up into the ventral membrane at the base of the claspers.

♀. Unknown.

Type: ♂. Southern California.

The unique type is the fifth specimen (as numbered) of the series associated together by Dr. Le Conte under the name *mixta*. As in the case of the preceding type it remains in that collection.

MISCELLANEOUS NOTES AND RECORDS OF LOCAL LEPIDOPTERA, AND DESCRIPTION OF TWO NEW ABERRATIONS.

BY FRANK E. WATSON,

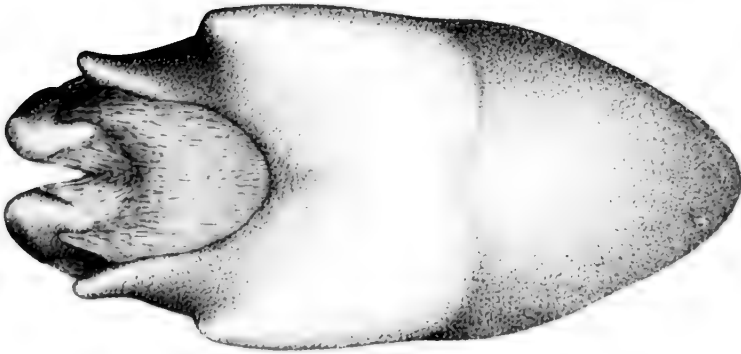
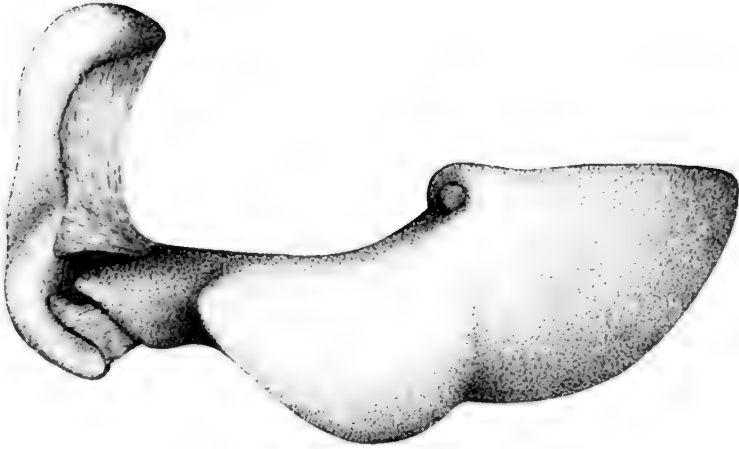
NEW YORK, N. Y.

BUTTERFLY COLLECTING IN THE VICINITY OF NEW YORK FOR THE SEASON OF 1920.

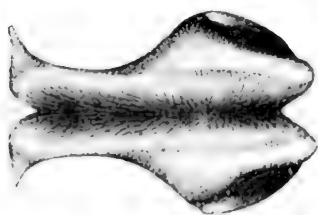
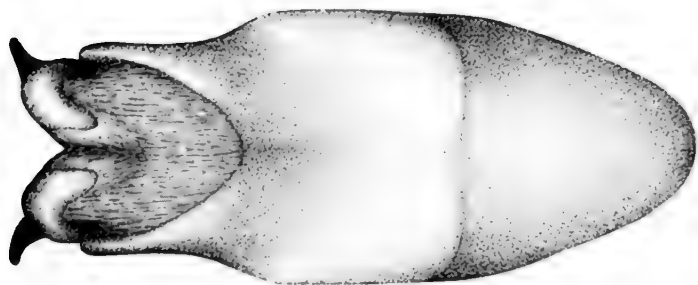
The exceedingly poor butterfly collecting in the vicinity of New York City this past season may perhaps be laid to the abnormal weather conditions, particularly to the greatly reduced amount of spring-like weather through March, April and May. Following a long cold winter, March was warm and springlike from the middle to the end of the month. It also had a remarkable number of clear days for that month in this vicinity. April gave us just five nice warm spring-like days. May was better with nineteen warm days, and being steadily warm after the 14th. The weather, during June, was normal. July and August were exceedingly hot, humid and rainy. When not actually raining it was damp and cloudy with rain threatening, so that there were few sunny days during these two months.

Cornus mass., a European Dogwood, produced its first flowers on April 1 in Colonial Park, New York City. The same shrubs last year flowered for the first time on March 18, *i.e.*, two weeks earlier. With the butterflies, at any rate, the season has apparently been about two weeks late, not becoming normal until about August 1.

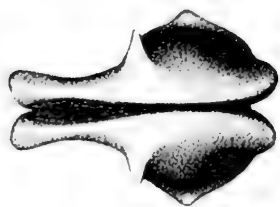
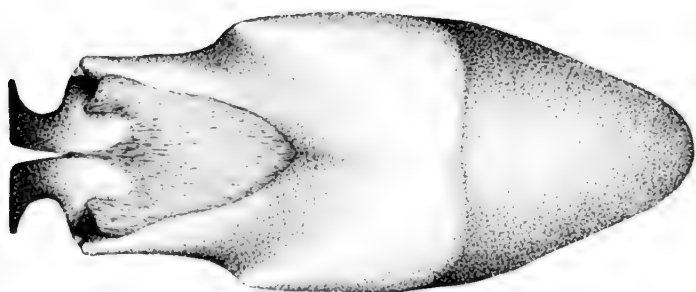
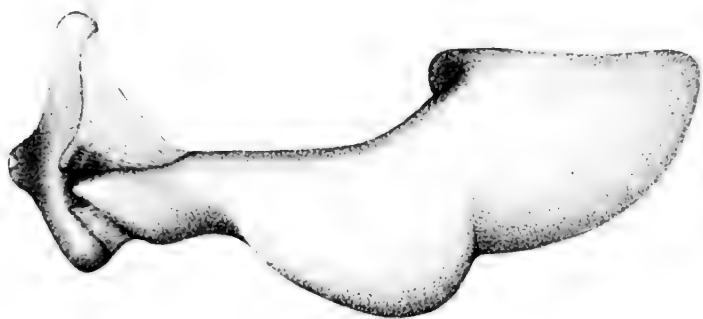
In Van Cortlandt Park, New York City, commencing with Au-



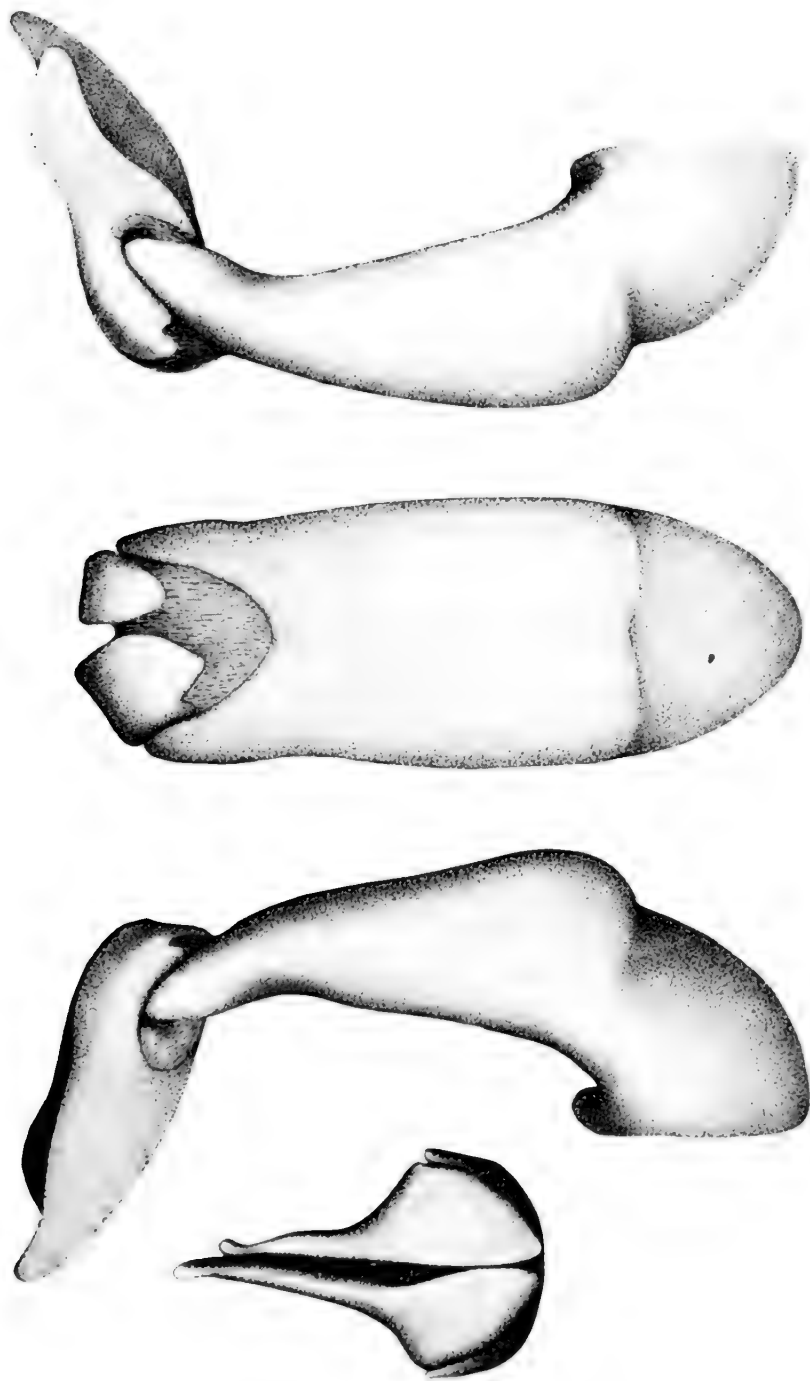
SERICA LECONTEI.



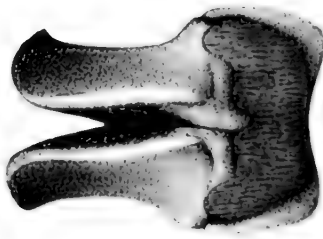
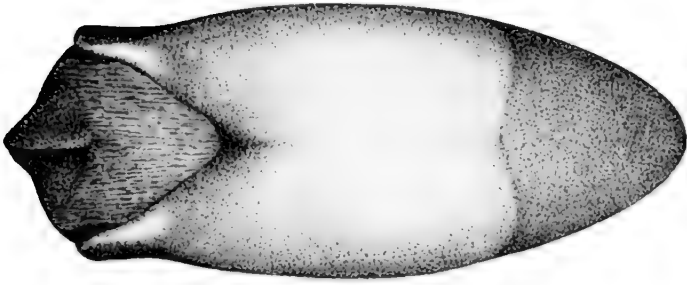
SERICA SPICULA.



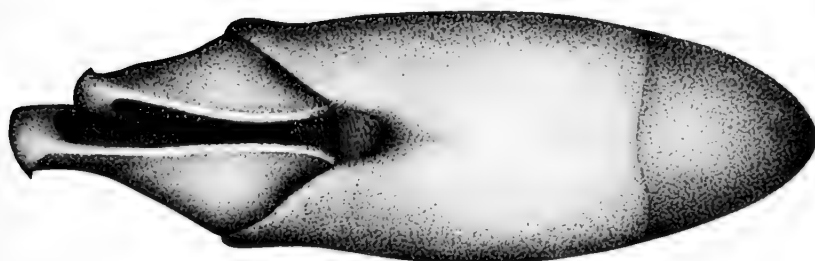
SERICA OPPOSITA.



SERICA VESPERTINA ACCOLA.



SERICA EGREGIA.



SERICA ABDITA.

gust 1 and lasting through the month and to about September 7, about sixteen of our commonest butterflies were very abundant and many of the less common species were observed. Prior to August 1 there was almost no collecting, while after September 7 the collecting became very poor again.

At Lake Mashipacong, Sussex Co., N. J., July 3 to 5, Mr. G. C. Hall and the writer enjoyed the hospitality of Mr. and Mrs. C. L. Robinson. Thirty-one species and four varieties were observed on the three days, among which were *Melitæa harrisi* Scudder, quite common but many specimens poor, and *Euphyes bimacula* (Grote and Robinson), rather common, all males, just coming out on the 5th.

At Jamesburg, Monmouth Co., N. J., August 29, with Mr. C. L. Lewis, thirty-two species and one variety were noted. This is my best butterfly list (for one day) of the season. Worthy of special mention are,—a single fresh male of *Poanes zabulon* (Boisduval and Leconte); *Megistias fusca* (Grote and Robinson), two individuals; *Pamphila leonardus* (Harris), about fifteen to twenty seen, very difficult to capture; *Catia otho egeremet* (Scudder), about six old specimens captured (late record).

Eurymus philodice (Godart) has been, as it usually is, very common but its dichromatic female form *pallidice* Scudder was rather scarce.

Correction.—The note on page 343 in "Miscellaneous Collecting Notes for 1919" should read, *E. philodice* is commoner than it was during 1917 but is by no means in its normal abundance.

Danaus archippus (Fabricius) has been, like last season,¹ nearly absent, only five individuals (listed below) being seen by me or brought to my attention and no eggs or larvae were found.

One specimen at Parsippany, Morris Co., N. J., June 27 (G. C. Hall).

One old female near Van Cortlandt Park, New York City, August 3 (H. Mills).

One individual, Van Cortlandt Park, August 18.

One specimen, Mastic Beach, Long Island, New York, September 20 (J. T. Nichols).

¹ Miscellaneous Collecting Notes for 1919. Watson, F. E., JN. N. Y. ENT. Soc., 1919, XXVII, p. 343.

One specimen near The American Museum of Natural History, October 11.

I have always considered this species one of our commonest local butterflies and I cannot recall a season, those of the present and preceding years excepted, when it was not plentiful. This being a migratory species, perhaps some catastrophe occurred to the migrating swarms, such as has been recorded for migrations of birds and certain mammals.

Vanessa virginiensis (Drury): One individual taken at Garden City, Long Island, New York, on the morning of November 21 by J. T. Nichols. It was sluggish when found on the top of a dead dry weed.

Vanessa cardui (Linné) has been with us again this season but was scarce.

Basilarchia archippus (Cramer): correction. On p. 343, l. 6, in "Miscellaneous Collecting Notes for 1919," *D. archippus* should read *B. archippus*.

Pieris napi virginiensis Edwards.

Following the Barnes and McDunnough Check List of Lepidoptera, 1917, this butterfly is here given as a race of *Pieris napi* (Linné). I am inclined to think that this may be a distinct species, for among other things, it seems to have but one generation a year, *napi oleracea* (Harris), the more northern insect, having two.

The name *virginiensis* has not heretofore appeared in any of our local lists, specimens recorded as *napi* (Linné) or *oleracea* (Harris) are probably of this form. As this is a very rare butterfly in the vicinity of New York City, records from the following specimens, which I have examined, may be of value.

Good figures of *virginiensis* are given by W. H. Edwards in his *Butterflies of North America*, Vol. I, 1871, Pl. IX, figs. 5-8.

One female, in fair condition, Paterson, Passaic County, New Jersey, May 6 (J. A. Grossbeck); in the collection of The American Museum of Natural History. This specimen is recorded as "*P. oleracea* Bdv." on p. 417, of Report New Jersey State Museum—Insects of New Jersey (1909), 1910, by J. B. Smith. It was probably taken in the vicinity of Garrett Rock (Watchung Mountains).

One female, in poor condition, Watchung Mountains, New Jersey, May 6, 1900 (W. D. Kearfoot); in the collection of The American Museum of Natural History. A pencil label attached to the specimen says "Garrett Rock," so that this individual was probably captured in the same general region where the preceding and following butterflies were taken.

One male, in good condition, Watchung Mountains, between Paterson and Great Notch, Passaic County, New Jersey, April 30, 1905 (F. E. Watson); in author's collection.

One old male, Blairstown, Warren County, New Jersey, June 2, 1920 (A. B. Klots); in the collection of A. B. Klots.

Argynnis aphrodite alcestis Edwards.

On page 45 of the Bulletin of the Brooklyn Entomological Society, 1913, Vol. VIII, I recorded the capture of a specimen of *alcestis* Edwards in Van Cortlandt Park, New York City. As two races cannot occur in the same region, this specimen should be reduced in rank to an aberration of *A. aphrodite aphrodite* (Fabricius). While it is practically identical in appearance with *alcestis*, its blood relationship is with *aphrodite* and *alcestis* should not be considered one of our local entities.

Brenthis bellona ab. *kleenei*, new aberration.

This aberration differs from typical *bellona* (Fabricius), in having the entire area of both wings black from the base to just inside the extra-mesial series of round black spots. On the primaries there is a distinct subquadrate spot of fulvous near the center, and an obsolete line (scarcely discernible) of the same color at the end, of the cell. There is a dusting of fulvous scales at the base, extending along the costa to nearly the middle of the wing and along the inner margin to the fulvous terminal area. The extra-mesial series of spots is greatly reduced, the upper three being obsolete, the two between veins 2 and 4 are strongest. The geminate submarginal band is practically obsolete. The outer series is reduced to a slight dusting of black scales on the veins and the inner row to a series of four faint rounded spots between veins 2 and 6. This series of spots is also closer to the extra-mesial series than in normal individuals. Secondaries with an obsolete (scarcely discernible) fulvous line at the end of the cell. The spots of the extra-mesial series are all present but smaller than normal. The submarginal series of elongate spots is also present but reduced and somewhat suffused, and together with the marginal series of T-shaped spots (which are also suffused) forms an indistinct blackish marginal band. This band merges with the black basal area at

the apex. Fringes of both wings blacker than normal. Underside of primaries similar to upper but with the addition of a small distinct fulvous spot at the base, and an obsolete line before the distal end, of the cell. There is also a faint fulvous streak below vein 2 near the base. The deep cinnamonaceous marginal border is interrupted by a yellowish apical patch and obsolete patches of the same color between veins 3 and 5. Underside of secondaries with the area, which was black above, chestnut, except as follows. A yellow bar along the precostal vein. A large lilacinous patch at base of cellule 7-8, acuminate distad along vein 8 and terminating near the center of the wing. This patch encloses near its base a round chestnut spot. A mesial series of four yellow annuli, the first between veins 1a and 1, second and third between 1 and 2, and fourth at distal end of cell between 3 and 5, the middle discocellular forming its outer edge. This, the fourth, annulus is less well defined than the others and it has a horizontal lilacinous streak on its lower edge extending distad to the outer edge of the chestnut area. The chestnut area is also interrupted by blackish patches near the bases of cellules 2-3, 3-4, and 4-5, the last being obsolete. The brown distal area is overlaid with iridescent violet scales. The brown submarginal crescents and extra-mesial annuli are present but more obscure than in normal individuals. Fringes of both wings blacker than normal.

Expanse.—43.5 mm.

This is a black *bellona*, with a fulvous terminal band on the primaries about 4 mm. wide and a subterminal band of the same color on the secondaries, about 2.5 mm. wide.

This beautiful aberration was captured by Mr. S. Kleene, after whom it is named, at West Hartford, Connecticut, May 3, 1921.

Holotype female, in the collection of The American Museum of Natural History; donated by Mr. S. Kleene.

***Aglais antiopa* (Linné).**

A patch of eggs was found by me on the underside of a willow leaf at Tappan, Rockland County, New York, Aug. 4, 1918. They covered nearly the basal third of the leaf extending to the edges and down to the petiole. It is somewhat unusual to find eggs of this species on a leaf as they generally encircle a terminal twig.

***Poanes hobomok* ab. *pallida*, new aberration.**

This aberration differs from typical *hobomok* (Harris) in having the usual dark brown borders and markings of all wings, above and below, light gray and the normal bright tawny areas and spots on both wings above and on primaries beneath pale dull tawny. Secondaries beneath with the band and subbasal spot light dull yellow. Fringes of both wings above and below grayish.

Expanse.—31 mm.

Holotype, male, near Dunwoodie, Westchester County, New York, May 21, 1921 (F. E. Watson); in the collection of The American Museum of Natural History.

♦

CORRECTIONS AND ADDITIONS TO THE LENG LIST OF COLEOPTERA. FAMILY BUPRESTIDAE NO. 1.

BY ALAN S. NICOLAY,

BROOKLYN, N. Y.

Since the completion of the text in 1918 and its publication during December, 1920, there have been certain corrections made and many new species described in the family Buprestidæ. It is the purpose of the present article to record all such forms and varieties together with a bibliography through 1920 including not only references to where the original description of mentioned species may be found, but also listing the more important papers, written since the Leng list and dealing with Buprestidæ but which contain no new names.

Certain forms described in 1918 are included in the list while others were published too late. The genera *Cinyra*, *Pachyschelus*, and *Taphrocerus*, which have been reviewed recently, are copied in their entirety.

The writer desires to take this opportunity to thank Mr. Harry B. Weiss of the New Jersey State Department of Agriculture for bringing to his attention several obscure references.

POLYCESTINI.

Acmaeodera Esch., 29-9.

- | | |
|--|-------------|
| A. marginenotata Chev., 67-583..... | Cuba, Fla. |
| <i>cnbacola</i> ‡ Duv., 57-57 | Cuba, Fla. |
| A. sinuata Van Dyke, 19-152..... | Cal. |
| A. sinuata var. sex-notata Van Dyke, 19-153..... | Cal. |
| A. wenzeli Van Dyke, 19-154..... | Tex. |
| A. wheeleri Van Dyke, 19-155..... | Ariz. |
| A. squamosa Van Dyke, 19-186..... | Ariz., Tex. |
| A. 14-spilota Obenb., 17-55..... | N. A. |

Paratyndaris Fisher, 19-92.

This genus should replace *Tyndaris* Thom., 57-168, for all North American species. *Tyndaris* is confined to South America.

P. coursetiæ Fisher, 19-93.....Ariz.

CHALCOPHORINI.

Agæocera Water., 82-4.

A. scintillans Water, 82-4.....Mex., Ariz.

BUPRESTINI.

Trachykele Mars., 65-149.

T. hartmani Burke, 20-169.....Cal.

Dicerca Esch., 29-9.

D. lugubris LeC., 59-200.....Mich.

A valid species and not synonymous with *tenebrosa* (Kby.), 37-155.

Cinyra¹ Cast., 37-157.

(*Spectralia* Csy., 09-175.)

C. purpurascens Schffr., 05-127.....L. Cal.

C. robusta Chamb., 20-241.....Tex.

C. prosternalis Schffr., 04-205.....Tex.

C. gracilipes (Melsh.), 46-145.....E. U. S., Tex., Wis.

macilentata (Csy.), 09-176.....Tex.

abbreviata Csy., 14-361.....N. C., Ill.

ocularis Csy., 14-362.....Ill.

Buprestis L., 60-408.

B. nuttalli var. *alternans* (LeC.), 59-207.....W. U. S

Incorrectly placed in the list as a variety of *læviventris* (LeC.), 57-43.

Melanophila Esch., 29-9.

M. atropurpurea (Say), 23-160.....Tex., Ariz., Kan.

A valid species and not synonymous with *acuminata* (DeG.), 74-133.

Anthaxia Esch., 29-9.

A. æneogaster var. *prasina* Horn, 82-108.....Cal.

¹ Arrangement follows Chamberlin's key, Ent. News, 1920, Vol. XXXI, p. 243.

CHRYSOBOTHRINI.

Chrysobothris Esch., 29-9.

- C. atrifasciata* LeC., 73-332.....Ariz., N. Mex.
 Erroneously spelled *atrofasciata* in the list.
C. orono Frost, 20-232.....Me.

AGRILINI.

Agrilus Steph., 30-239.

- A. viridis*¹ var. *fagi* Ratz., 39-63.....Europe, N. J.
A. dozieri Fisher, 18-67.....Fla.
A. criddlei Frost, 20-249.....Manitoba, Ont., Quebec
A. restrictus Water., 89-119.....Mex., Ariz.
A. juglandis Knull, 20-7.....Pa.
A. frosti Knull, 20-8.....Pa., Mass.
A. celti Knull, 20-11.....Pa.

*Pachyschelus*² Solier, 33-313.

Metonius Say, 36-264.

- P. purpureus* (Say), 36-164.....E. U. S., Tex., Iowa
americanus Gory, 41-346.....M. & W. States
P. lævigatus (Say), 36-164.....E. U. S., Iowa
ovatus || (Say), 25-252.
punctatus (Gory), 41-347.
carbonatus (LeC.), 59-252.
politus Kerr., 96-322.
P. schwarzi Kerr., 92-298.....Fla., Ga., Ark., Tex.
cæruleus || Sz., 78-364.
P. schwarzi var. *oculatus* Schffr., 09-377.....Ariz.

Brachys Sol., 33-312.

- B. cuprascens* Blatch., 13-23.....Fla.
 On the authority of Mr. Charles Schaeffer this species is a synonym of *floricola* (Kerr.), 00-347.

*Taphrocerus*² Solier, 33-314.

- T. puncticollis* Sz., 78-363.....Fla., Ala.
T. schaefferi N. & W., 20-144.....Tex.

¹ Introduced from Europe.

² Arrangement follows Nicolay and Weiss, JOURN. N. Y. ENT. SOC., 1920, Vol. XXVIII, pp. 136-150.

- T. agriloides** Cr., 73-75.....Ala., Ga., Tex.
T. lævicollis LeC., 78-403.....Fla.
T. gracilis (Say), 25-252.....E. U. S., Tex., Ariz., Col.
alboguttatus (Mann.), 37-120.....(So. Cal.?)
cylindricollis Kerr., 96-312.....Pa.
? *texanus* Kerr., 96-312.....Tex.
T. albonotatus Blatch., 19-29.....Fla., Ga.

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² Exclusive of papers in bibliography of Leng list.

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1920. State of N. J., Dept. of Agriculture, Circular No. XXXI, p. 9 (Notes on Food Habits of *Brachys*).

MISCELLANEOUS NOTES.

Lathridiidae in the heart of New York City (Coleop.).—Many species of the beetles of this family have been found to be cosmopolitan, and the following incident would lend plausibility to the assumption that not only are they generally widely scattered, but much more abundant than the scant material in collections would lead one to suspect. During the past summer, while I was away in the country, a leak in the plumbing in my city house soaked the wall against which stood a large number of beetle boxes. Upon examining the latter after discovering the condition of the wall, I was aghast at the mass of mould, white, green and yellow, which completely covered the specimens and a great part of the lining of the boxes. Their contents seemed irretrievably lost; but I determined to do what I might to save something from the wreck. In this, by the way, I was highly successful, succeeding in removing the mould and cleaning the specimens with a camel's-hair brush and a solution of carbolic acid. But while engaged in this work I found between one and two hundred live specimens of Lathridiidae, evidently attracted to the boxes by their moist, mouldy condition. Four species were represented, all of them originally described from specimens taken in localities far removed from our shores, and so far as known by no means common in this country. The question presents itself: How then did they find those mouldy boxes in a "brown-stone front" of a New York City block? If not indigenous (though their original discovery elsewhere does not necessarily preclude such a possibility), commerce is of course responsible for their introduction here. But whatever their origin, it would seem by no means improbable that they may be present almost anywhere that offers conditions favorable for their sustenance and reproduction, and that dusty crevices in our city houses (between floor boards, etc.) may have their Lathridiid content wholly unsuspected by us, even though we regard ourselves as observant coleopterists; and owing to their

extremely small size and secretive habits only an accident, as in my experience, might bring them to our attention. As it happens, none of the several species taken by me under the above conditions has heretofore been recorded from New York. They are as follows: *Adistemia zeatsoni* Woll., originally described from Funchal in the island of Madeira. Also taken in the Canaries, Algeria, Cape of Good Hope, Venezuela and Chili, and in this country recorded from Washington, D. C. This species in numbers far exceeded the others found in the mouldy boxes. *Cartodere costulata* Reitt., taken in Japan and Germany, and in this country recorded from Mass., Penna. and Mich. *Cartodere elegans* Aubé. From the Mediterranean region, and in this country recorded from Washington, D. C., only. *Corticaria fulva* Com. Cosmopolitan, recorded here from Mass., Va., Ky., Mich. and Lower California. For the foregoing records I am indebted to Mr. H. C. Fall's review of the family published in Trans. Am. Ent. Soc., XXVI, pp. 101-190. Apparently the beetles in question subsisted entirely on the mould, as no evidence whatever was discovered of any consumption of the mounted beetles in the invaded boxes.—LEWIS B. WOODRUFF.

BOOK REVIEWS.

LES INSECTES. ANATOMIE ET PHYSIOLOGIE GÉNÉRALES. INTRODUCTION À L'ÉTUDE DE L'ENTOMOLOGIE BIOLOGIQUE. BY C. HOULBERT. Second, revised edition. One volume superroyal 18mo, 380 pp., with 207 text figures. Librairie Octave Doin, Paris, 1920. Price: francs 8.00, unbound; francs 10.00, cloth bound.

This handy little volume is part of an "Encyclopedia of Science" published under the direction of Dr. Toulouse and covering all branches of human knowledge. It contains a general account of the structure and habits of insects. Intended as an introduction to the study of entomology, it admirably serves its purpose. After a short definition of the class Insecta, the reader plunges at once into a fascinating history of entomology. Perhaps this part of the book will be most popular with the advanced entomologist because it contains so many little-known details of the life and work of the early French entomologists. It is rather curious that the author does not point with pride to the Entomological Society of France as the senior scientific body exclusively devoting its activities to the study of insects. Its first meeting was held

February 29, 1832, while the next oldest association of the kind, the Entomological Society of London, assembled for the first time on May 3, 1833. Of American entomologists only three are mentioned by name, viz., John Le Conte, "whose ancestors were French, native of Normandy," Charles Riley, and L. O. Howard. The omission of reference to the pioneer of American entomology, Thomas Say, shows the need of a modern biography of this great naturalist.

The manifold features of insect morphology are treated in about 60 pages, while more than half of the book is devoted to physiological and biological considerations. This arrangement of subject matter is unusual in manuals dealing with insects, but, I believe, most satisfactory, since it will undoubtedly arouse the beginner's interest in the biological side of entomological science. Following a short chapter on embryology, the larval and nymphal stages are fully discussed. The book concludes with a consideration of insects in their relations to mankind (economic and applied entomology); this part also contains chapters on the means of defense of insects, on their geographical distribution, and on the fossil forms.

Apart from its didactic value to the beginner, this manual contains much theoretical matter which renders it a welcome addition to the entomologist's general library. I may call attention to the chapters dealing with the theory of the PROTENTOMON (pp. 35-37); the metameric origin of the head (pp. 58-59); the theory of flight in insects (pp. 150-152); histolysis during metamorphosis (pp. 263-273); etc. Such and other critical discussions of controversial subjects are most acceptable in an elementary textbook and will help to emphasize the philosophical aspect of entomology. American readers will be somewhat surprised to find the chapter on wing venation (pp. 78-84) wholly devoted to an exposition of Woodworth's views. It is difficult to understand why Comstock and Needham's valuable work has been overlooked, since it enjoys at present much popularity, both here and abroad.

The classification of insects into nine orders, as briefly outlined at the end of the volume, can hardly be justified and is neither practical nor in accordance with theoretical views. It must, however, be conceded that the delimitation of orders in the class Insecta is most unsatisfactory at present. Handlirsch's division into 34 orders now seems conservative in view of the fact that their number has been increased to 69 by two recent German authors!

The style of this manual is a good example of attractive and lucid concision, a quality seemingly peculiar to the best French scientific writers. It comes as a welcome relief after the brain-racking phraseology of certain modern "Handbücher." The price of this handsomely bound, clearly printed, and profusely illustrated volume should furnish food for thought for many an American editor.—J. BEQUAERT, American Museum of Natural History.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF DECEMBER 21.

A regular meeting of the New York Entomological Society was held at 8:00 P.M., on December 21, 1920, in the American Museum of Natural History, Vice-President John D. Sherman, Jr., in the chair, with 16 members present.

Mr. Albert Effingham Lawrence, 105 West 69th St., was elected an active member.

Mr. Davis proposed for active membership:

Mr. Herbert F. Schwarz, 383 Park Ave.

Dr. Harry H. Knight, St. Paul, Minn.

Mr. Watson proposed:

Mr. Alexander B. Klots, 125 West 78th St.

On motion, the by-laws were suspended and the three candidates were elected.

On motion by Mr. Schaeffer, the society's subscription to *Catalogus Coleopterorum Junk* was withdrawn.

Mr. Weiss exhibited the insecticide catalogue of Sherwin-Williams Co., commenting on its serious scientific errors.

Mr. Weiss also read a paper on "The Insects of the Spreading Dogbane," illustrated by specimens in adult and immature stages, which will be published elsewhere in full. Reference was made to a paper in *Ohio Journal* by Raymond C. Osburn and some of the details were discussed at length by Dr. Bequaert, Mr. Davis, and Mr. Burns, with the conclusion that the species of *Apocynum* involved would affect the conditions.

Mr. Notman having assumed the chair, Mr. Sherman exhibited and discussed "The Biographies of Thomas Say," including the *Memoir* by George Ord, read before Am. Philos. Soc., Dec. 19, 1834; *Biog. Sketch* by Benj. N. Coates, read before Ac. Natural Science, Phila., Dec. 16, 1834; *Thomas Say* by F. M. Webster, in Vol. VI of *Ent. News*, 1895.

With the copy of Ord's *Memoir*, from Dr. Le Conte's library, was a letter of Mrs. Say protesting against Ord's literary criticism. Mr. Sherman showed illustrations of Say's portrait, first and last home in Indiana, and of his monument, and described his expedition to Florida and the Northwest as well as his devotion to science.

Mr. Davis called attention to the long time Mrs. Say survived her husband, her death occurring at Lexington, Mass., Nov. 15, 1886, and to her having lived on Staten Island, where she was elected the first honorary member of its Natural Science Association.

Mr. Richardson spoke of his collecting experiences in Virginia and of his happy association at Washington with Dr. Schwarz.

MEETING OF JANUARY 4.

The annual meeting of the New York Entomological Society was held in the American Museum of Natural History on Tuesday, January 4, 1921, Vice-President John D. Sherman, Jr., in the chair, with 18 members present.

The Nominating Committee submitted the following list of candidates for officers in 1921:

President—John D. Sherman, Jr.
Vice-President—Harry B. Weiss.
Secretary—Charles W. Leng.
Treasurer—William T. Davis.
Librarian—Frank E. Watson.
Curator—A. J. Mutchler.

Executive Committee.

H. G. Barber,	Geo. I. Engelhardt,
Joseph Bequaert,	C. E. Olsen,
L. B. Woodruff.	

Publication Committee.

Howard Notman, Chairman,	Charles Schaeffer,
Frank E. Lutz,	E. L. Dickerson.

There being no other nominations, the Secretary was instructed to cast one affirmative ballot electing the candidates proposed by the Nominating Committee.

On motion by Dr. Bequaert, the Secretary was instructed to ascertain from Messrs. Leonard & Johannsen the present status and future plans of New York State List.

The Secretary presented for M. C. Houlbert a complimentary volume of *Encyclopedie Scientifique*.

Dr. Lutz reported as the Society's delegate to Chicago meeting that entomology was well represented, about 100 papers having been presented.

Mr. Leng's catalogue of Coleoptera was exhibited by advance copies, Mr. Sherman stating that the binding of the whole edition would be finished about January 20. He spoke of the interest Mr. Henshaw had shown and the thanks due him. Mr. Leng spoke of the thanks due Mr. Mutchler and of the advantage of printing such corrections as might prove necessary in one publication, the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

Mr. Nicolay exhibited his collection of the "Pselaphid Tribe Brachyglutini," reviewing the classification, methods of collecting, especially sifting

vegetable debris at base of trees in fall and under stones in spring, and called attention to the discovery of *Batrissodes caseyi* Dury on the Palisades. He also spoke of Mr. Davis finding the Seydmanid *Connophron elongatum* in Cape May Co., N. J.

Mr. Weiss read a paper on "Coleoptera of the Milkweed," which will be published entire, illustrated by specimens of adult larva and work of the different species, especially *Tetraopes*, of which he gave the first complete life history.

Mr. Dickerson followed with a paper on "Other Insects of the Milkweed," treated in the same way, which also will be published in full.

The work of these two members was freely discussed and greatly admired.

Mr. Shoemaker gave an account of "Beetle Collecting at Washington, D. C.," during 1920, with an exhibition of the many fine species he had caught, including records for *Leptura americana* and *Cacophia pubulata*.

Mr. E. A. Chapin and Prof. H. C. Fall, present as visitors, spoke briefly on the work that they had recently done.

Mr. A. S. Van Winkle, also present as a visitor, made an interesting address on his recollections of the entomologists of 40-50 years ago, especially referring to Louis Agassiz, C. V. Riley, Otto Lugger, and Dr. John C. Kucklin.

MEETING OF JANUARY 18.

A regular meeting of the New York Entomological Society was held at 8:00 P.M., on January 18, 1921, in the American Museum of Natural History, President John D. Sherman, Jr., in the chair, with 13 members present.

Edward Davis Quirnsfeld, 523 4th St., Union Hill, N. J., was proposed as an active member by Mr. Mutchler.

Mr. Notman, under the title "Notes on Staphylinidæ," presented, with blackboard illustrations, a graphic account of the wealth of structural characters possessed by that family of beetles. The head was first considered with respect to its form, and its modifications in its various parts; the mouth parts, the antennæ, and the sutures were discussed in detail. The thorax, the elytra, the mesocoxal parts followed. The exhibit accompanying Mr. Notman's remarks, taken from his own collection, showed 150 genera, all but 3 or 4 of the North American tribes, with many rare and minute species, including the remarkable *Beyeria* found by Mr. Gustav Beyer in Arizona. Mr. Notman spoke without notes and displayed a remarkable familiarity with his subject.

Dr. Bequaert spoke of the genus *Poderus* as the cause of an epidemic of blisters in the Congo. The beetle alighting on the skin at night would be crushed by the sleeper's hand. A red spot followed in a few days by a vesicle containing a little cerosity results and leaves a scar. He had notes showing that this occurred in southern Russia, Khartoon, and Brazil, as well as in the Congo.

Dr. Bequaert presented a "Review of C. Houlbert's 'Anatomie et Physi-

ologie Générales' in the *Encyclopedie Scientifique-Insectes*," saying that it contained rather more than would be found in Comstock's "Introduction to Entomology," and in general very ably presented. The history of entomology and entomologists was very interesting, though it treated rather unduly of the French, and the treatment of wing venation seemed to lay undue stress upon the theories of Woodworth. In this connection he called attention to the excellent paper in *Ann. de la Soc. Ent. de France*, LXXXIX, 1920, pp. 1-50, "La Nervation alaire des Coléoptères," by A. d'Orchymont. Dr. Bequaert praised highly the moderation shown in dividing insects into orders as opposed to the excessive subdivisions of Handlirsch and other German authors.

In reference to the history of entomology, Mr. Sherman recalled the paper by John G. Morris in *Silliman's Journal*.

Mr. Watson, under the title "Notes on Lepidoptera," exhibited the milkweed butterfly, with many interesting aberrations and some of its foreign relatives. His remarks thereon will be printed in full.

Mr. Davis exhibited a bound volume of W. D. Funkhouser's papers.

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